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Contributions to the Theory of Warning Colours and Mimicry. No. IV. Experiments with various Birds. Summary and conclusions.

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Introduction.

In accordance with the intention implied in previous papers of this series, (*J. A. S. B.* LXIV, *Pt. II*, 1895 *p.* 344; LXV, *Pt. II*, 1896, *p.* 42; LXVI, *Pt. II*, 1897, *p.* 528). I give in this, the final paper thereof, an account of my experiments with birds other than the Babblers (*Crateropus canorus*) to which my first paper was devoted, together with a general summary and conclusions.

Some of the experiments herein detailed had already been made when my paper on the Babblers was published, and I have made many others since.

Most of these have been made with birds of the Passerine order, the largest and most important of all the groups of birds commonly regarded as of ordinal value. And among these I have paid particular attention to the birds of the Babbler group * generally, that being one

* Unfortunately great difference of opinion prevails among ornithologists as to the extent and limits of this group of birds, the "family" *Crateropodidæ* or *Timeliidæ* of authors.

For the purposes of this enquiry I restrict the term "Babbler" to species belonging to Mr. Oates' (Fauna of British India, Birds, Vol. I), "sub-families" *Crateropodinæ*, *Timeliinæ*, *Sibiinæ*, and *Liotrichinæ*. I have experimented with none of the *Brachypteryginæ*; and though inclined with Mr. Oates to rank the

in which I am specially interested, so that I was led to keep many of the species in order to observe them in life.

In fact, the experiments in this paper are often not very systematic, since experimenting on this subject was not always my main object in keeping birds at all.

The keeping of many specimens of one or several groups of birds together is not the best possible way at arriving at experimental results, and many of the present experiments were made under these conditions, especially those in which Babblers of different kinds were concerned. And for this I feel some apology is due to investigators.

Considering, however, the largely arboreal habits of many Babblers, and their abundance in this Oriental region, I do not think that any great harm will result from the particular attention I have given to their tastes in the matter of insects.

SECTION I.

Miscellaneous experiments with various Birds, mostly belonging to the Babbler and Bulbul groups, and kept together. Series A.

I commenced this series of experiments in 1895, soon after releasing the Babblers dealt with in my first paper, *J. A. S. B.* LXIV, *Pt. II*, 1895, *p.* 344. The birds used were kept in the aviary vacated by these, and were fed on seed and fruit.

The insectivorous birds at first put in were four Red-whiskered Bulbuls (*Otocompsa emeria*) and five Liothrix (*Liothrix luteus*); but before long one of the former and two of the latter escaped. Other birds were put in afterwards, as noted below, including another species of Bulbul.

Bulbuls live largely on fruit, but also devour insects, in doing which they do not use their feet to hold their prey, but depend entirely on their beaks; they have considerable swallowing power. Many species are found in the African and Oriental regions.

The Liothrix uses its foot to grasp its prey, like *Crateropus canorus*, which it resembles in many of its habits. This bird is very active and intelligent, and feeds on fruit and seed as well as insects. It is well-known to amateurs of birds in England as the Pekin Robin; and has a certain resemblance in size, &c., to the true Robin. It is common in the Himalayas and extends into China.

Brachypodinæ or Bulbuls with the more typical members of the Babbler group I here treat of them as a separate one, that being the position assigned to them by several ornithologists.

They are less active on their legs and more so on their wings than the Babblers proper, a very practical distinction in habits for those considering the relations of birds to insects.

The experiments were usually on consecutive days.

I. Put into the aviary an insect-cage containing a number of non-warningly-coloured butterflies (*Papilio demoleus*, *Catopsilia* and *Junonia*), with one *Delias eucharis** and four *Danais chrysippus*. Two *Catopsilias* were taken when they came out by Liothrix, while a *D. chrysippus* was not. I then took out the butterflies and put them into the aviary through the netting. Presently a Bulbul deliberately took a *D. chrysippus* and ate it whole, though it might have had other butterflies.

I then saw another *D. chrysippus* eaten whole by a Bulbul. The Liothrix did not seem to attack them, though they took *Junonias*. I saw a Liothrix take a *Catopsilia* after rejecting a *D. chrysippus*. It then left this and took a *Junonia*, which it ate nearly whole.

I then saw a Bulbul take a *D. chrysippus* (the only butterfly near it) which it prepared to swallow, but dropped accidentally; what happened next I did not see.

II. Put into the aviary a number of non-warningly-coloured butterflies and two *D. chrysippus;* the latter were not attacked by the Liothrix, but eaten whole by two Bulbuls, being the first butterflies attacked (they were nearest) by these birds, which did not, at any rate immediately, eat others. Both sexes of *Elymnias undularis* were among the insects put in, and I saw the females were not avoided by the Liothrix, but seized.

III. Put in a number of non-warningly-coloured butterflies and four *Danais chrysippus*. One *Danais* was eaten by a Bulbul, and one taken and left by a Liothrix, these birds attacking other butterflies.

Another Bulbul took a non-warningly-coloured butterfly, and a third a *Papilio demoleus*, which seemed to give it much trouble, and it did not eat it. A Bulbul then flew down and took and ate a *D. chrysippus*, though there were other butterflies on the floor. (I have seen a Liothrix peck the wings of a *Catopsilia* and then leave it).

Neither Liothrix nor Bulbuls offered to touch a *Delias eucharis* even when it fluttered close to them.

Two *D. chrysippus* and some other butterflies were uneaten, and the birds were going to roost, when I put in a number of *Danais chrysippus*, and some *D. limniace* and *Euplœa*. None were attacked as far as I saw. The Bulbuls should have been hungry, as there was no fruit in the cage at the time, though I then put in some.

* Another specimen of this species was the only butterfly that remained uneaten from the previous day, when I had given many butterflies and seen both warningly-coloured and harmless species attacked, before regularly taking these notes.

IV. The *Delias eucharis* put in the previous day was still alive and not much torn, while of the other butterflies I found only wings left. There was no fruit in the cage but a partly eaten orange which I had put in at the same time as the butterflies. I put in some cockroaches, which, like the *D. eucharis*, were not attacked. Later on in the day I found the *D. eucharis* dead, but uneaten. The cockroaches got away under the drinking vessel.

I put into the aviary a large insect-cage containing various butterflies, mostly warningly-coloured ones; a *Limenitis* and two *Danais* (*chrysippus* and *genutia*) first came out, and the former was seized by a Liothrix, which could just as easily have taken a *Danais*. The Liothrix did not take any insects from the cage, but one then caught, tore, and apparently ate the *D. genutia* which had come out. They tried, however, to get at the insects through the glass, and then one came to the entrance and took a non-warningly-coloured butterfly.

I then took out the cage and put its contents into the aviary. I did not see the Liothrix eat any more *Danais*—on the contrary, I several times saw them take a non-warningly-coloured butterfly when they could easily have had one of these.

I saw a Bulbul swallow a *D. chrysippus*, and two *D. chrysippus* and a *D. limniace* taken, beaten, and dropped by this species. There was plenty of fruit in the cage.

When the birds were going to roost the only non-warningly-coloured butterflies left out of about a dozen were one *Elymnias undularis* ♂ (dead), and a *Nepheronia hippia* ♂. These two I took out and reserved, with two *Danais chrysippus*. (I could not find them, however, when I wanted them next day).

V. The *Delias eucharis* mentioned in the account of the experiments of the previous day, was still uneaten, though the other butterflies seemed to have been devoured.

I put in some more butterflies, and saw that though the Liothrix readily attacked *Danais* at first, they took non-warningly-coloured butterflies when they had the choice.

I now added to the collection two common Bulbuls (*Molpastes bengalensis*), and four Button-Quails (*Turnix taigoor*), and put in some more butterflies, including a *Papilio aristolochiæ*.

This time again the non-warningly-coloured species were obviously preferred by the Liothrix.

At some time or other to-day I saw a *D. chrysippus* swallowed whole by a Red-whiskered Bulbul, and another eaten by a Liothrix, which species also ate a *Danais limniace*. I also saw a common Bulbul reject a *D. chrysippus*, many of which species had been given.

Next day all the butterflies were gone (I did not notice the *Delias eucharis*) but the *Papilio aristolochiæ*, which was not even hurt till the afternoon, when a Bulbul killed it, and some bird, I think, afterwards ate the abdomen. Yet the birds had no insects to-day. The Liothrix often pecked at the wings lying about.

VI. I put into the aviary a number of butterflies, the non-warningly and warningly-coloured species being fairly equal in number, the former comprising *Catopsilia*, *Junonia*, &c., and the latter being chiefly *Danais chrysippus*.

The Liothrix only attacked non-warningly-coloured species at first, as far as I could see, and the Button-quails also seemed to like these best, for I saw one swallow a *Catopsilia*, and they eagerly pursued Liothrix which had one of these or another non-warningly-coloured butterfly in their possession. On the other hand, I saw a *D. chrysippus* worried by one, but I am not sure that it was eaten.

The Common Bulbuls made no attempt to eat any butterflies but one *D. chrysippus*, which was taken and I think eaten by this species, even with other butterflies about. I saw the Red-whiskered Bulbuls eat two *D. chrysippus;* I forget whether at this particular time there were non-warningly-coloured butterflies about, but when there were these birds made no attempt to eat them.

The Liothrix afterwards attacked and ate some of the warningly-coloured kinds; I saw an *Euplœa* and a *D. genutia* taken and eaten even when two *Elymnias undularis* ♂ were in the aviary. I had put in two males of this species and one female (in bad condition and much torn) with their upper surface displayed; but the first bird that came (a Button-Quail) chose the female first.

The Bulbuls had had no food for two hours at least, and ravenously devoured part of a plantain put in. When the birds went to roost the only butterflies unhurt were a *Papilio aristolochiæ* and some *D. chrysippus;* a *P. demoleus* lay dead.

A *P. polites* was soon killed, though I did not see it done, and I think a Button-Quail ate it.

VII. Next morning all the butterflies appeared to have been eaten but the *Papilio aristolochiæ*, which was still alive, though in the afternoon I found it dead, but uneaten.

About 5 P.M. I put in first a *Delias eucharis*, which was attacked and devoured whole by a Button-quail, which had yet not eaten the *P. aristolochiæ*.

I then put in another *P. aristolochiæ* and a *P. polites*, together. The latter was almost immediately attacked by the Liothrix, and I think partly eaten, while a Button-Quail swallowed the remainder. The

former was not molested by either kind of bird, though they looked at it. Having given a Liothrix a *Huphina phryne* in my fingers from outside, I then offered, one in each hand, a *Hypolimnas misippus* ♀ and a *Junonia*. The latter was taken, but it was nearest the bird; immediately afterwards another Liothrix tried to take the *Junonia*.

I repeated the experiment with this mimic and a *Catopsilia;* this time the bird chose the *Catopsilia*, though not nearest.

I repeated the experiment with the mimic and another *Junonia;* the bird crossed over from the perch nearest the *Hypolimnas* to that nearest the *Junonia*, and took this.

I repeated the experiment with the *Hypolimnas* and a *Huphina phryne;* the birds were timid, but both insects were approached, and the head of the *Hypolimnas* snatched off; but when I left both stuck in the netting, a Liothrix took the *Huphina*; it was taken from it by a Button-Quail. I stuck the mimic and a small ferruginous butterfly in the netting; the first Liothrix chose the latter.

I put in a *Danais chrysippus*, which a Liothrix immediately seized, and I saw it at least partly eaten, I suppose by the same bird.

I offered a *D. chrysippus* to the Button-Quail, which took and killed it, but it was taken from them and eaten by a Liothrix.

I put in two *P. demoleus* and two *D. chrysippus;* one of the former was taken and rejected by a Red-whiskered Bulbul. I saw one *Papilio* eaten by a Button-Quail, and I think the other was. Of the *D. chrysippus* one was swallowed whole by a common Bulbul, and one killed by a Button-Quail, which lost it to a Liothrix, which ate it.

I put in then six *D. chrysippus*, which were attacked by the Liothrix and Red-whiskered Bulbuls, and I saw two swallowed by the latter birds. While some of these *Danais* were alive, I put in three more, and saw two worried and partly at least eaten by Button-Quails.

As the birds were now going to roost, I ceased experimenting, leaving three *D. chrysippus* and a *P. aristolochiæ*, alive, and another of the latter species dead, in the aviary. There was still a little fruit left, and there was always seed in the cage.

The Bulbuls had no chance at any non-warningly coloured butterflies.

VIII. Next day, no butterflies visible in the morning but the two *Papilio aristolochiæ*, that left living still alive, though injured. I put in specimens of *Danais genutia*, *D. chrysippus*, and *D. limniace*, and *Euplœa*, which were attacked readily by the birds. I saw a Button-Quail swallow an *Euplœa*, and a Liothrix drop one. This I have seen Liothrix do before, but I believe it will eat this species.

There was no fruit in the cage. All the butterflies soon disappeared. I put in some fruit, which the Bulbuls ate ravenously.

IX. Next day there was no trace of the two *Papilio aristolochiæ* but a wing.

I put in first a *Delias eucharis*, which a Button-Quail ate. Then I put in a *Danais chrysippus*, which was soon seized by a Liothrix.

I then put in three non-warningly-coloured butterflies, and one each of *D. chrysippus*, *D. genutia*, and *D. limniace*. The Liothrix first took two of the non-warningly-coloured specimens, then one took the *D. genutia*, and then another the third non-warningly-coloured specimen. The *D. genutia* ultimately fell mostly to the share of a Button-Quail, and the *D. limniace* appeared to be eaten by a Liothrix.

While the *D. chrysippus* was still alive in the aviary, I put in one specimen each of *D. genutia* and *D. limniace*, and also a *Catopsilia* and a *Junonia*. The latter was seized by a Liothrix, and a Button-Quail attacked all three *Danais*, but finished by eating the *Catopsilia*. A Liothrix then ate the *D. genutia*.

While these still were in the cage *D. limniace* (alive) and *D. chrysippus* (dead), I put in three fresh specimens of *D. genutia* and *D. chrysippus*, and *Euplœa*, and several non-warningly-coloured specimens. These last were soon attacked by the Liothrix, and the Button-Quails ate some, though the former *D. chrysippus* lay there dead.

A Liothrix, seizing by accident a *D. limniace* and a non-warningly-coloured butterfly together, let the *Danais* drop and retained the other.

While the *Danais* only were still noticeable in the aviary, I put in a *Junonia*, which was soon seized by a Liothrix, obviously by choice, as the others were mostly close by.

One *D. chrysippus* was then attacked by a Button-Quail, and part at least eaten by a Red-whiskered Bulbul. The non-warningly-coloured butterflies were now all gone; two Button-Quails swallowed the *Euplœa* and a *D. chrysippus*, which a Red-whiskered Bulbul (weakly) had tried to eat. The *D. limniace* had also by this time disappeared (I think eaten by a Liothrix after the non-warningly-coloured butterflies were gone); the *D. genutia* was still alive.

I then put in one specimen each of *P. polites*, *P. demoleus*, *D. chrysippus*, *D. limniace*, and *Euplœa*.

The birds now mostly wanted to rest, but the Button-Quails (assisted perhaps by a Red-whiskered Bulbul) soon finished all but a *D. genutia* and a *D. limniace*, and these were soon dead and mangled.

I then put in a number of *D. chrysippus*, two or three *D. genutia* and two *Euplœas*, a *Junonia*, and an *Elymnias undularis* ♀.

The *Junonia* was unmistakeably singled out for attack and seized by Liothrix, which next attacked the two *Euplœas*, and I saw one eaten, and have no doubt the other was.

I saw *D. chrysippus* attacked both by this species and by Red-whiskered Bulbul, and then left off watching, being convinced already that Liothrix preferred the non-warningly-coloured butterflies. I was not so sure about the Bulbuls, which I saw this time neglected all butterflies, when both sorts were together, and yet they eat warningly-coloured ones.

The birds had had a good meal of fruit before I began experimenting. The fate of the *Elymnias undularis* ♀ I did not see, but I expect that, like *P. polites*, it was not a good enough mimic to escapes as I have seen it before seized by Liothrix. The rest of the butterflies were soon eaten.

Experiments with various Birds. Series B.

About this time I released all the Bulbuls. A day or two afterwards I noticed a bit of a *Papilio aristolochiæ* on the floor. For several days now the birds had practically no insects but those they could catch casually. I gave them, however, two *Euproctis* moths one day. One was eaten by a Button-Quail the other by a Liothrix, which latter did not seem to relish it much. Wild birds do not seem to eat this species, though helpless by day at any rate and easy to see. I then commenced another series of experiments.

I. I offered a *Nepheronia hippia* ♀ with a *Danais limniace*, a *Catopsilia*, and two other non-warningly-coloured butterflies. These last three were seized by the three Liothrix, and a Button-Quail disabled the mimic, which I took out.

I offered the *N. hippia* with a non-warningly-coloured species, and the *N. hippia* was taken first, by a Liothrix (it was nearest). *D. limniace* was as yet untouched.

I put in *Euplœa*, *D. chrysippus*, and two non-warningly-coloured species, one a *Huphina phryne*. The former was taken by a Liothrix, but the bird hardly had a fair choice.

I put in *Euplœa*, *D. chrysippus*, *D. limniace*, and a *P. polites*; none were taken at once, but a Liothrix found and took a non-warningly-coloured one. Then *Euplœa* was taken.

I put in several *D. chrysippus*, with a *P. demoleus* and a *P. polites*, and a non-warningly-coloured specimen, which was picked out by a Liothrix.

A Button-Quail turned away from a *D. chrysippus* and ate the *H. phryne* previously put in, as mentioned above, and I suppose dropped by Liothrix. Soon after this I saw a Liothrix eat an *Euplœa;* and soon after I saw another eat a *D. limniace*, and another take a *D. chrysippus* which had been refused by a Button-Quail. The *Papilios* were still alive, as also one *D. limniace*, one *Euplœa*, and several *D. chrysippus*.

II. Next day, the only butterfly not torn was *Papilio demoleus*, and it soon disappeared.

I put in three *Atella phalanta* and one each of *Danais genutia*, *D. chrysippus*, and *Euplœa*.

Two *Atellas* were seized by two Liothrix; the third Liothrix took the *Euplœa*.

A Button-Quail ate the *D. genutia*, and then an *Atella*, which I don't think the birds saw at first.

The *D. chrysippus* was soon seized by a Liothrix.

I put in *Euplœa*, *D. chrysippus*, and two non-warningly-coloured butterflies. The latter were taken by Liothrix, one, an *Elymnias undularis* ♂, being obviously chosen in preference to *D. chrysippus*. While the *Euplœa* and *D. chrysippus* were untouched, I put in one *D. chrysippus*, one *D. genutia*, and two *Catopsilias*. The *Catopsilias* were chosen by Liothrix.

While two *D. chrysippus*, a *D. genutia*, and an *Euplœa* were in the aviary, I put in a *Huphina phryne*, which was taken by a Liothrix. I put two more in, but they were in a corner, and the birds did not seem to see them.

I put in then, the two *D. chrysippus* and a *D. genutia* and *Euplœa* being still alive, two *Papilio demoleus*, and two *P. polites*. One of the last fell to the ground and was swallowed whole by a Button-Quail; none of the other butterflies were attacked, not even the two *H. phryne*, which I picked out and put on a box. Here the Liothrix looked at them and one picked them up. Yet at this time a Liothrix caught mosquitoes.

The female Button-Quail (which had eaten the *P. polites*), now after many attempts swallowed the *D. genutia*, which was obviously too big for her. She had previously attempted to swallow an *Euplœa*, which when she left it was long pecked at by the male, and pulled to pieces, but little if any was eaten.

I put the two *Huphina phryne* on the floor, and a Liothrix pulled one about, but hardly touched it, though these birds took the remains of the *Euplœa* and picked at them.

However, a Liothrix soon after ate one of the *H. phryne*, while there were two *P. demoleus*, two *D. chrysippus*, and a *P. polites* in the aviary. I then put in a *Neptis leucothoë*, which was seized by a Liothrix, which dropped it, and another carried it up on to a box at the top of the aviary, where I did not see what happened further. then took out and reserved the two *D. chrysippus* and *P. demoleus*, and the *P. polites*, (a mimetic specimen), and reserved them, all unhurt. Part of a *H. phryne* still lay on the floor of the cage.

When I put in the butterflies I had reserved, the *Danais* was first attacked, then the *P. polites*; the *P. demoleus* was left a little time, then it disappeared, as the other two species had done.

III. I put in two *Danais chrysippus* and one *D. genutia* and three non-warningly coloured butterflies. The Liothrix took the latter first; then one took the *D. genutia*. The female Button-Quail apparently ate the two *D. chrysippus*, but she had no fair chance at the others.

A *Papilio aristolochiæ* put in was not touched by any of the birds. But a few hours after only a wing was left.

I put in one *D. chrysippus* and *Euplœa* and two or three non-warningly-coloured ones. These were taken first.

I put in a female of *N. hippia*, which was eaten by a Button-Quail.

I put in some *Danais* with *Huphina phryne* and other non-warningly-coloured specimens where the Button-Quails could have a choice; they did not seem eager for any, and certainly did not pick out the non-warningly-coloured ones. A Liothrix went on tearing a *Euplœa* even among these, and I think ate it.

Soon the Button-Quail ate a greyish butterfly, and a Liothrix took one of the *H. phryne*, while two *D. chrysippus* were still left.

An *Elymnias undularis* ♂ was in a corner, so I put it between the two *D. chrysippus*, whence a Liothrix took it.

In the evening I put in one each of *D. chrysippus*, *D. genutia*, *D. limniace*, and *Euplœa*, with a similar number of non-warningly-coloured butterflies. The Liothrix deliberately picked out three of these; I did not see whether they got the fourth. The Button-Quail swallowed the *D. chrysippus*. Then a Liothrix took the *Euplœa*.

IV. Next day, the *Danais limniace* put in yesterday had been eaten. I put in an *Euplœa* with two *Nepheronia hippia* ♂. A Liothrix took the *Euplœa* first, before I was fairly out of the aviary. Only the undersides of the *N. hippia* were visible.

When all these were eaten, I put in two *Papilio demoleus*, two *P. polites* (not much like *P. aristolochiæ*,) and two *D. chrysippus*. A *P. demoleus* was first taken, by a Liothrix. *P. polites* seemed to be looked at by these birds with some suspicion; yet one was soon taken, and another seized, pecked, and left, by them. This specimen, however, and both the *P. demoleus* (one of which I think was swallowed by the female Button-Quail) disappeared before one *Danais* did. This, however, afterwards disappeared.

V. Next day, I put in one each *Danais chrysippus*, *D. genutia* and *Euplœa*, with three non-warningly-coloured butterflies. The Liothrix took at the first attack the *Euplœa* and two of the non-warn-

ingly-coloured butterflies, while next one took the third, a *Catopsilia*, in distinct preference to the *D. genutia*. The *D. chrysippus* was swallowed by the female Button-Quail. I then saw an *Elymnias undularis* ♂ and a *Huphina phryne*, (which I put in) both taken by Liothrix, when there was another *D. chrysippus* in the aviary; but I doubt if they properly saw the latter. I then put in four *Papilio demoleus* and two *D. chrysippus* (one of the latter species being in the aviary still). A *P. demoleus* was first seized, by a *Liothrix*. The female Button-Quail took a *D. chrysippus*, but neglected the *P. demoleus*. A Liothrix then attacked the other *P. demoleus* but did not kill it; nor did the Button-Quails notice it, as it fluttered on the floor. I then turned in some small young cockroaches, which were greedily eaten by the Button-Quails, and also taken by Liothrix, (as, indeed, happened yesterday). Yet on that occasion I saw a Liothrix leave a cockroach, after having butterflies as now.

I saw the male Button-Quail look at and leave *P. demoleus*. Some hours afterwards all these butterflies were gone, and I put in two male *Hypolimnas* and two *Euplœas*. The first Liothrix took an *Euplœa*, the second a *Hypolimnas*, a Button-Quail the other *Hypolimnus*, and Liothrix the other *Euplœa*. All were eaten as far as I could see, but I don't think by their original captors exclusively.

I put in two more *Euplœas*, and two *Junonias* of different species; the first Liothrix took an *Euplœa*, the second a *Junonia*. A Button-quail got the other *Junonia*. One *Euplœa* was still in the cage when I put in a small Lycænid, which was eaten whole by a Liothrix. It was still there when I put in a *Huphina phryne*. This was not attacked at once; I blew it down, and a Button-quail ate it. The last *Euplœa* was then eaten by a Liothrix.

I put in a protective Satyrid and a *D. chrysippus*. A Button-quail ate the former. The *D. chrysippus* was still untouched when I put in several more, with one *D. genutia*, one *D. limniace*, and three *P. polites*. The Liothrix attacked none at once. A Button-quail pecked at *P. polites* and swallowed a *D. chrysippus* whole.

VI. The male Button-quail was now lost.

I put in three *Junonias* and one each of *Danais chrysippus*, *D. limniace* and *Euplœa*. The female Button-quail got one *Junonia*, and a Liothrix took the *Euplœa*, while a second *Junonia* was in a corner. I blew it out, when a Liothrix distinctly chose it before the two *Danais*. I think the Button-quail got the third *Junonia*.

While the two *Danais* were in the cage, I put in two *Junonias*. A Liothrix distinctly chose one before the *D. chrysippus*; the Button-quail got the other.

I put in another *Junonia* which was soon taken by Liothrix, though the *Danais* were still there. However, a Liothrix which had got part of the *Euplœa*, did not leave it for the *Junonia*.

I then put in several non-warningly-coloured and "protected" butterflies; the former nearly all disappeared first.

VII. I put in two *Catopsilias* and two *Delias eucharis*. The former were seized by Liothrix.

I put in four *Euplœas* and four non-warningly-coloured butterflies. An *Euplœa* was first taken by a Liothrix; then the rest of the non-warningly-coloured specimens disappeared. I saw two taken before *Euplœas* by the Liothrix. While three *Euplœas* were left, I put in another non-warningly-coloured butterfly, which was immediately seized by a Liothrix.

I then put in some more butterflies, including *Danais chrysippus*, *D. genutia*, *Papilio aristolochiæ* and a blue and black species, two *Huphina phryne* and *P. demoleus*. I put in one *H. phryne* before the other, but a Liothrix looked at and did not take it, and one of these birds took one of the *Euplœas*. All this time the Button-Quail did not attempt to eat the *Delias eucharis*, while it swallowed two *D. genutia*. The blue and black *Papilio* was killed and left by a Liothrix, swallowed by the Button-Quail. The *H. phryne* were eaten, by Liothrix I think, while some other butterflies yet remained untouched.

At the end of the afternoon only the two *Delias eucharis* were left, dead but uneaten, on the floor.

I then put in two or three non-warningly-coloured butterflies and three *Euplœas*; the Liothrix preferred the former. While one *Euplœa* remained untouched, I put in a *D. chrysippus* (a Liothrix had just taken one of the species) and three non-warningly-coloured butterflies, all of which latter were taken by the three Liothrix. This in spite of two of them, *Atella phalanta*, being tawny like the *Danais*.

While the *Danais* and one *Euplœa* were untouched (a Liothrix was eating another *Euplœa*) I put in another non-warningly-coloured butterfly. The first Liothrix was regarding it closely, when another took it.

I then put in six *D. chrysippus*, two *P. demoleus*, one *P. polites*, one *D. limniace*, and one *Nepheronia hippia* ♂. This last was the first seized by a Liothrix, which left it. It was, however, ultimately eaten by a bird of this species. But they seemed less keen on butterflies than previously.

VIII. Next day in the morning I found only the two *Delias eucharis* and a *Papilio aristolochiæ* left. In the evening they still lay there.

I put in two *P. polites*. The first, a non-mimetic one, was looked

at, but not touched, by the first Liothrix and the Button-Quail; the second, though much more like *P. aristolochiæ*, was very soon taken by a Liothrix.

I then put in some *Danais chrysippus*, *D. genutia*, *D. limniace*, and *Euplœa*. The Button-Quail swallowed two *D. chrysippus* at least. I think the *Euplœas* disappeared first.

IX. In the afternoon, next day, all the butterflies were gone, but the two *Delias eucharis* and the *Papilio aristolochiæ* left before. The aviary was now cleaned out, and I put in two *P. aristolochiæ* and a *P. polites* (not much like the protected species). The latter was at once seized by a Liothrix. One of these birds and the Button-Quail looked at but did not touch, the others. I put in an *Euplœa* and three *Junonias*. Two at least of the latter were taken by Liothrix in obvious preference to the former. I put in five more non-warningly-coloured specimens. One was seized by a Liothrix, the *Euplœa* being still there. A Liothrix then took one from the Button-Quail, as had happened with one of the three *Junonias* above-mentioned.

Another *Junonia* was put in, and seized by a Liothrix. All the five non-warningly-coloured butterflies were eaten before the *Euplœa*, or any of half-a-dozen *Danais chrysippus* and a *D. genutia* which I had now put in.

X. I put into the aviary two *Papilio aristolochiæ* and two mimetic specimens of *P. polites*. The first one, put in together with the two *P. aristolochiæ*, was deliberately looked at and taken by a Liothrix. Then I put in the second, dead, on the floor. The Button-Quail immediately attacked it, but a Liothrix took it away twice; for the former bird left it at first, after knocking a bit off. The Liothrix evidently observed the difference in these two species. I then put in some *Danais chrysippus*, and one each of *D. limniace*, *Euplœa*, and *P. demoleus*. The Button-Quail attacked the last, and the Liothrix ate part of it, and then one took the *Euplœa*, but with no great eagerness. I saw none of the *D. chrysippus* eaten, and the *P. aristolochiæ* were not killed.

XI. Next day, no butterflies left but the two *Papilio aristolochiæ*, which were able to fly away.

I added two common Bulbuls (*Molpastes bengalensis*) to the aviary.

I then put in the evening three *Danais chrysippus*, an *Euplœa*, and several non-warningly-coloured butterflies, including some *Papilio polites* and a *P. demoleus*. The *Danais* and *Euplœa* were not taken by the Liothrix as long as any others remained.

The Bulbuls showed no distinct tastes, but were very wild.

XII. I put in, in the morning, several non-warningly-coloured butterflies, with some *Danais chrysippus* and an *Euplœa*. The former

all disappeared before the *Danainæ*, most being taken by the Liothrix, but one large specimen by a Bulbul. The latter birds were hungry. I saw a Liothrix take a *Junonia* when close to the *Euplœa*.

I then put in two *Papilio polites*, one of which was immediately attacked by a Liothrix, *D. chrysippus* being at hand. A *P. demoleus* was eaten before the other butterflies, which had, however, disappeared in the evening, when I put in some more, mostly *D. chrysippus* and *Euplœa*, with two *Delias eucharis*. I did not see these taken. A solitary *Junonia* given was seized with obvious preference by a Liothrix.

Experiments with various Birds. Series C.

The present series was conducted with one of these Liothrix only,* but several Bulbuls were used; the two *Molpastes bengalensis* noted a few lines above, and two each of the Red-whiskered (*Otocompsa emeria*) Yellow-vented (*Molpastes leucotis*) and White-crested (*Pycnonotus sinensis*) species (not Indian). The Button-Quail had been removed.

I. I put in four *Danais chrysippus* and about six non-warningly-coloured butterflies. The Liothrix took one of the latter, and the Common Bulbuls ate two *D. chrysippus*. I also saw this species taken by one Yellow-vented Bulbul; the other took a non-warningly-coloured butterfly. A bird of this species then ate readily a *Delias eucharis* given, though they had had non-warningly-coloured butterflies, and there was also fruit.

When all the butterflies put in were gone, I introduced six or seven *Papilio polites* and a *D. limniace*, and three *Huphina phryne*. A White-crested Bulbul ate one of the *P. polites*, and one tried at the *D. limniace*, and I think ate the head, but a Common Bulbul took the butterfly away and swallowed it. The Liothrix took a *P. polites*.

Two *Huphina phryne* were the last butterflies I saw eaten, one by a Yellow-vented Bulbul and one by a White-crested.

II. Next day I put in three *Papilio aristolochiæ* and two *P. polites*. I saw the Liothrix with one of the latter, and a Common Bulbul eat readily a *P. aristolochiæ*. And as all the insects soon disappeared, the Bulbuls must have eaten the others also.

III. Next day I put in nine non-warningly-coloured butterflies, two *Euplœas*, two *Danais limniace* and a *D. chrysippus*. The last was taken by a Common Bulbul, though there were plenty of other butterflies, and eaten as far as I saw, and this bird then took a non-warn-

* But all were together with these Bulbuls a little while, and at this time one day I put in a number of butterflies, mostly "protected" kinds. I thought the Bulbuls did not much relish them, but all soon disappeared. I think I saw a Common Bulbul drop an *Euplœa*.

ingly-coloured specimen. A Red-whiskered Bulbul made its first attempt on a *D. limniace*, though non-warningly-coloured butterflies were at hand. The Liothrix took two of these latter. The White-crested Bulbuls took some non-warningly-coloured butterflies, and pecked and left *Euplœa* and *D. limniace*, the only Danaids I saw them try; this when the other butterflies were gone.

The Yellow-vented Bulbuls ate only non-warningly-coloured butterflies as far as I saw.

The last two butterflies left were an *Euplœa* and a *D. limniace*. But a Red-whiskered Bulbul took and swallowed the *Danais*, and the White-crested Bulbuls, after much battering of it, apparently disposed of the *Euplœa*, which they evidently did not relish. One of these latter birds had eaten a *Papilio polites* I put in readily enough, and two *P. demoleus* disappeared, I suppose eaten by the Bulbuls. There was very little fruit left, and the birds appeared to be hungry.

In the evening I put in a *P. aristolochiæ*, which was seized and killed by a White-crested Bulbul; this bird did not appear to relish it much, and seemed inclined to abandon it, when it was snatched away by a Yellow-vented Bulbul. After this bird had knocked off all the wings, a Red-whiskered Bulbul got the body but soon dropped it. Then one White-crested Bulbul took and dropped it; then the other bird of this species manipulated it for a time till it was snatched away and ultimately eaten by one of the Yellow-vented species!

IV. I put in some *Euplœas* and *Danais chrysippus* and one or two *D. genutia*, with a few other butterflies.

The Liothrix took a *Junonia*, a Yellow-vented Bulbul a *D. chrysippus*. I saw a White-crested Bulbul take and drop a *D. chrysippus*; nevertheless one of these birds ate one, the other an *Euplœa*. I then saw a White-crested Bulbul take and drop an *Euplœa* with apparent distaste.

All the butterflies were soon taken, the few non-warningly-coloured ones disappearing first. These were smaller. A female *Elymnias undularis* was eaten, I do not know by what bird, but it did not seem to be avoided.

In the evening I offered the Liothrix the choice of *Nepheronia hippia* ♀, and a rather larger non-warningly-coloured species. After some hesitation he took the latter, and a Yellow-vented Bulbul immediately seized the *Nepheronia*, but I took this away.

I then offered it again to the Liothrix with a male of the same species, and he took it (the female). But he was perhaps in fear of a Common Bulbul which approached. However, he dropped it accidentally when I scared him off to try again fairly, but I found the Bulbuls made this impossible, so I allowed them to get both specimens.

I then put in a number of butterflies, mostly *Papilio polites* and *P. demoleus*, with several *Euplœas*, one or two *D. genutia* and *D. chrysippus*, and one *P. eurypylus* and two or three other non-warningly-coloured butterflies.

A Yellow-vented Bulbul attacked first one of the last-named. A White-crested Bulbul took and rejected an *Euplœa*, but I saw one of these birds swallow a *P. polites*, and one eagerly pursue a *Junonia*, which was ultimately taken by a common Bulbul, I think because it was nearest; at any rate the bird left it, and took a *P. demoleus*. Then the Liothrix, which had had a *P. polites*, took this *Junonia*.

I saw one of the White-crested Bulbuls flick away a *P. demoleus* as if distasteful, but I also saw a specimen of this butterfly manipulated by a bird of this species.

While *P. polites* and *P. demoleus* were still available, a male *Elymnias undularis*, which had escaped from a White-crested Bulbul early in the progress of this experiment, was alive in a corner apparently unnoticed. I blew it out, and it settled further up, when after a little time a Red-whiskered Bulbul took and ate it.

One White-crested Bulbul then after long manipulation swallowed a *P. demoleus*, not appearing to relish it.

The *P. eurypylus* was attacked by a Yellow-vented Bulbul, but I found it later, apparently unhurt save for the loss of a wing. Yet a little while afterwards it had disappeared, while a *P. polites* and *P. demoleus* were still left alive when the birds roosted. There was fruit in the cage.

V. Next day, both these butterflies left overnight had disappeared.

At the end of the afternoon (there being fruit in the cage) I put in eight *Danais chrysippus*, and a similar number of non-warningly-coloured butterflies, and a hawk-moth. I placed these on the ground, decapitated, instead of offering them alive as usual.

I saw Bulbuls of the Yellow-vented, White-crested, and common species eat *D. chrysippus*, and these were all gone before the other butterflies, which were inconspicuous on the sand. But the Liothrix saw and selected the latter, and did not eat any *Danais*, though he had been eating their heads with those of other butterflies as I picked them off. I saw one White-crested Bulbul eat a *Danais* and then a *Junonia*, while its fellow was engaged with a non-warningly-coloured species. The Yellow-vented Bulbul I saw eat a *Danais* did not seem to like it much. I then put in a *D. genutia*, an *Euplœa* (dry and without abdomen) and a male *Nepheronia hippia*, dead. A Common Bulbul ate the *D. genutia*, and a White-crested one the *Nepheronia*. I put in

then a live *Euthalia lubentina*, which was eagerly chased; a Yellow-vented Bulbul either lost it or let it escape, and a Common Bulbul swallowed it. I have seen the common *Euthalia* eaten on this occasion and before. Even the *Euplœa* soon disappeared.

VI. About this time I put in a number of "protected" butterflies of several species with a *Papilio demoleus*, which the Liothrix took. I saw a White-crested Bulbul swallow a *Danais chrysippus*.

VII. I put into the aviary three *Danais chrysippus* and seven non-warningly-coloured butterflies. I did not see what the Liothrix took.

The Yellow-vented Bulbuls took non-warningly-coloured ones, one Common Bulbul a *Danais chrysippus*, and the other a non-warningly-coloured species.

I saw a White-crested Bulbul reject a *D. chrysippus*, and both of them reject non-warningly-coloured specimens. All the *D. chrysippus* were eaten by the common Bulbuls, except part of one which a Red-whiskered Bulbul took (other butterflies all gone apparently) and a Common Bulbul snatched away.

The White-crested Bulbuls did not seem eager for any butterflies. There was fruit in the cage at the time.

I then put in some *Papilio polites*, some mimetic, but most not so, with one *P. aristolochiæ*.

The Liothrix did not take any. I saw a White-crested Bulbul with one of the mimicking specimens; the other also had a *P. polites*, and one bird at least appeared to eat its prey. The common Bulbuls swallowed one at any rate. All of this species soon disappeared. But the *P. aristolochiæ* was looked at by the Liothrix, and pecked by both the White-crested Bulbuls, which afterwards cleaned their beaks with evident disgust; one of these birds had I think disabled the insect at the first attack.

I then put in two *Neptis kamarupa*, with a *D. limniace*, three *P. demoleus*, and a *Delias eucharis*. One of the *Neptis* was swallowed by one White-crested Bulbul, while the other bird of this species took a *P. demoleus;* I did not see whether it ate it. One pecked and left the *D. eucharis*. I saw one try at the *D. limniace* at first, but it escaped. I also saw this butterfly get away from a Common Bulbul, but a Red-whiskered Bulbul seized it, and it soon disappeared. Soon the *P. aristolochiæ* and the *D. eucharis* were the only butterflies left. The Liothrix took none of these butterflies, though eating fruit and the head of something.

This same individual again took part in a further series of experiments, which I record below. Three more Liothrix were added, the other birds used now being a Chloropsis (*Chloropsis aurifrons* or

malabarica) some Zosterops and two Yellow-vented (one new) and one Red-whiskered Bulbul only. The Chloropsis is a leaf-hunting bird, arboreal in habit, and also capturing insects on the wing. It does not use its foot in manipulating its prey, and swallows large insects with difficulty. The genus is widely distributed in the Oriental region. The Zosterops are very small birds, and of little or no importance in this connection.

Experiments with various Birds (on plain diet) Series D.

I. Offered the Chloropsis heads of different butterflies; he ate those of non-warningly-coloured species readily, but refused heads of *Danais chrysippus*, wiping his beak after trying these. I put a number of live *Euplœas* and a *D. chrysippus* into the aviary, and one of the former was seized by a Yellow-vented Bulbul, while a Liothrix soon after took another, which I did not see it eat. In fact, I soon afterwards saw one of these birds take and drop one. I offered the Chloropsis a *Papilio polites*, and while he was looking at it a Liothrix (the original bird) took it away, and proceeded to eat it, while there were plenty of *Euplœas* about. The birds had had very few insects for several days.

I then pulled off the wings of a *P. polites* and offered the body to the Chloropsis, which he took very readily, but dropped it (after some manipulation), as also did two Liothrix in succession.

The other day the Chloropsis had readily seized a large non-warningly-coloured butterfly, but it was snatched from him.

I then put in specimens of *D. limniace*, *genutia*, and *chrysippus*, and *P. demoleus*, none of which I saw taken, though I saw a Liothrix catch a *D. genutia* (I think) and let it go again, and the Chloropsis flew at some butterfly but did not catch it.

The Yellow-vented Bulbul apparently ate the *Euplœa* which, as stated above, it attacked, and I saw a bird of this kind attacking another *Euplœa*.

I offered the Chloropsis a male *Elymnias undularis*. He took it immediately, and manipulated it till he lost it by accident, and a Liothrix (the original bird) took it. I cannot say whether this bird ate it, as I saw a Yellow-vented Bulbul with part. Just then another Liothrix had an *Euplœa*. While watching the Chloropsis I saw a Liothrix take and drop a *D. genutia*.

The Chloropsis then readily took and with some trouble ate a *Junonia*. He readily eats small moths and flies.

I left the Liothrix at night attacking *Euplœas*, but they were not eager. Next day all the butterflies were gone.

I now released one of the Yellow-vented Bulbuls, which was weakly, and added a Red-whiskered Bulbul. I must also have put in another of the former species, though my notes do not say so (see *infra*).

II. I gave an *Acræa violæ* to the birds; a Liothrix took it, but a Yellow-vented Bulbul snatched it and after much mumbling, ate it. Removed the Red-whiskered Bulbul again.

III. Put in in the morning several "protected" butterflies, mostly *Euplœas*, with one *Delias eucharis*. The birds were not keen, except one of the Yellow-vented Bulbuls; the butterflies, however, were all gone later on.

I offered the head of an *Acræa* to the Chloropsis, but I am not quite sure what he did with it. He took and dropped the head of a *Papilio nomius;* but ate two heads of *P. demoleus*, and several heads of non-warningly coloured species. I then put in three *Junonias* and a male *Hypolimnas* with two *P. demoleus*. One Yellow-vented Bulbul immediately attacked the *P. demoleus* and ate one; a Liothrix got the other, and at the same time other Liothrix got most of the non-warningly-coloured butterflies; I saw the last taken as the Bulbul finished eating its prey.

I then put in a *Junonia*, another non-warningly-coloured butterfly, and two *Acræas*. The *Junonia* was soon seized, I think, by a Liothrix, and a Yellow-vented Bulbul then took the second non-warningly-coloured one, which it apparently ate. It then ate in succession the two *Acræas*, apparently with no great relish; but this Bulbul, owing I think to its small bill, is not good at eating butterflies.

One of the *Acræas* had been tried and left by a Liothrix, and another was trying it, but left it quite readily on the Bulbul's approach.

The keenness of the Liothrix for the *Junonias* contrasted strongly with their indifference to the *Euplœas*.

I then put in the *P. nomius*, which was before long seized by a Liothrix. A Bulbul also appeared anxious to obtain it. Presently it was dropped,—how, I did not see—but soon taken again by another Liothrix. A Zosterops took it from him, and commenced to eat it, when a Bulbul snatched it, then a Liothrix got it again, and I think it was eaten by one of the last named. I have seen the Chloropsis with bits of wing in his bill, once of *D. genutia*, and just now he swallowed a bit of an *Euplœa's* wing.

I now (next day) commenced to give the birds a daily supply of live maggots, a man coming for the purpose, who also gave grass-hoppers. As this alters the conditions of the experiments somewhat, I commence here a new series, begun next day.

EXPERIMENTS WITH VARIOUS BIRDS (ON MORE LIBERAL DIET) SERIES E.

I. I offered two *Terias* to the birds; a Liothrix took and left one, then, with no great relish, apparently, ate the other. Meanwhile another Liothrix took and left the first specimen. This was not eaten immediately at any rate, but next morning I did not see it.

II. I put many "protected" butterflies into the aviary, mostly *Euplœa* and *Danais limniace*, but also a *D. chrysippus* or two and a *Papilio aristolochiæ*. The Liothrix soon attacked the *Euplœas*, and a Yellow-vented Bulbul took a *D. limniace*, which it ultimately swallowed, I believe, after much trouble. I also saw it with an *Euplœa*, and (I believe the same bird) with another *D. limniace*.

I put in a *Catopsilia*, which was soon taken, though (as above stated) there were many other butterflies, by a Liothrix, which was tearing it to pieces, when her own mate forcibly drove her off, and after pecking at the butterfly with no great relish, left it. I saw an abandoned *Euplœa* close by, and this morning I have seen Liothrix eating these.

A Zosterops took an *Euplœa*, and picked it a bit but then dropped it.

The Chloropsis attacked the butterflies, but did not seem able to manage them. But later in the day I saw him swallow with some trouble the body of an *Euplœa*. Only a few butterflies were now left; of these an *Euplœa* and a *D. chrysippus* were feeding on the birds' fruit. The *Catopsilia* was now gone.

I saw a Liothrix leave the body of an *Euplœa* after stripping off the wings.

Later on, towards evening, I gave the Chloropsis a very small non-warningly-coloured butterfly, which he ate, and after that a *Terias*, which he also ate.

I offered him two heads of *D. chrysippus*, the first of which he flicked away, and the second he only just touched once. He then immediately took and ate the head of a *Catopsilia*. I could not get him to touch the heads of two *Euplœas*, but it was near roosting-time.

One *Euplœa* and the *P. aristolochiæ* were still uneaten. I took out the *Euplœa* and put in a *Catopsilia*, which was soon taken and disposed of by Liothrix, apparently with no great relish.

III. Next day in the morning while there were still maggots in the cage, gave the Chloropsis a skipper, which he ate with difficulty, getting it the wrong way at first. In the evening, the *Papilio aristolochiæ* put in yesterday had its wings pulled off, but was still uneaten. I put in another, and several non-mimetic *P. polites*. The birds did not seem eager for them, although a Liothrix had taken a non-warningly-coloured butterfly readily, before they were put in.

I put in three *Terias* and a *Huphina phryne*, which were all eaten by the Liothrix in preference to *P. polites* and *aristolochiæ*, but with no great relish, as I saw one bird leave a *Terias*.

A Liothrix picked off part of the abdomen of a *P. polites* and left it, still living, with signs of (apparent) dislike. However, one of these birds (I do not know whether the same) returned to the attack, and most, if not all, of the insect was eaten. I saw a Liothrix take up and drop the body of yesterday's *P. aristolochiæ;* to-day's specimen had not been molested as yet.

When the birds went to roost, three *P. polites* and the *aristolochiæ* were left.

IV. Next day in the morning, all the *Papilio polites* had been eaten, but the *P. aristolochiæ* had not, the last specimen not being even torn. Later on I saw the dried body of the earlier specimen lying about, and some wings, presumably of the other. I put in one specimen each of *Euplœa*, *Danais genutia*, *chrysippus* and *limniace*, with about an equal number of non-warningly-coloured butterflies. The Liothrix and one or both Yellow-vented Bulbuls attacked the latter and consumed them all before the Danais were touched; the first insect taken being one of the non-warningly-coloured ones, by a Bulbul, which bird however swallows even smallish species with difficulty (*see* above).

The Chloropsis swallowed pieces of wing from the non-warningly-coloured species, but I did not see if this was by preference. (This morning the birds had had no maggots so far as I knew). A Liothrix attacked the *D. genutia*, but did not eat it all, and the three other "protected" butterflies were still alive when I put in, shortly after, another *D. genutia* and *chrysippus* and a non-warningly-coloured specimen. The last was soon taken by a Liothrix.

A *D. chrysippus* was then pecked and left, at the same time that another Liothrix was eating a *D. genutia*. I then put in a *Neptis kamarupa*, which was looked at by one Liothrix, taken and eaten, after rather tentative pecking, by another.

Meanwhile the Chloropsis attacked the *Euplœa*, but did not capture it. This *Euplœa*, the *D. limniace* and *genutia* and two *D. chrysippus* were still uneaten when I put in a dead and rather dry specimen of *Papilio demoleus*, which the Chloropsis seized, but when he had battered off most of the wings, he lost it to a Liothrix, which in turn appeared to have lost the body to a Bulbul, which bird ate it.

I saw the Chloropsis look at the *Euplœa*, and then take a piece of dead wing. When I left the birds a Liothrix was eating *D. genutia*, and another attacked and left *D. chrysippus*.

When all the above butterflies seemed to have been eaten, in the

evening, I put in about twenty *Euplœas* and a male *Hypolimnas*. This last was singled out for persecution by the Liothrix and a Yellow-vented Bulbul, and though its size and activity gave trouble, it was at last, falling in the water vessel, caught firmly by one of the former birds, and eaten by a bird of this species, which threw up the body once, but eagerly took it again.

Meanwhile the other Yellow-vented Bulbul was worrying an *Euplœa*, which I suppose it ate. I saw no other *Euplœas* eaten at the time, and both the unoccupied Bulbul and the other Liothrix wanted to get the *Hypolimnas* from its owner. I saw *Euplœas* taken and relinquished by Liothrix at least twice, though they ate rice and milk (for the last few days I have been giving them sweetened sop made thus or with bread, which seems much to their taste and probably lessens their readiness for butterflies).

The dry body of one *aristolochiæ* was still about. At night about a dozen *Euplœas* were still left in the cage.

V. Next morning some of the *Euplœas* put in over-night were gone, but two or three remained alive. In the evening all were eaten. I then put in a male *Hypolimnas* and a female *Nepheronia hippia*. The former was first attacked by a Liothrix, but before it succeeded in catching it, another seized the mimic, which had settled with its wings closed while the other was being chased.

I saw a Bulbul in possession of both, but the *Hypolimnas* was snatched from it by a Liothrix just as it had nearly got rid of the wings.

I put in five *Papilio aristolochiæ* and two non-mimetic specimens of *P. polites*. One of the latter was soon knocked into the water, and another taken and torn by a Liothrix, which (or another of the same species) was about to eat the body, when a Bulbul snatched it and appeared to eat part.

I found the bodies of four *Euplœas* in the cage, as well as the old *P. aristolochiæ*, though the birds had much fewer maggots this morning than usual.

I took the first *P. polites*, still living, out of the water and laid it on the ground. But both it and the *P. aristolochiæ* were untouched when the birds roosted.

To-day they ate none of the plantain supplied, seeming to prefer the rice and milk. For a day or two I have noticed little plantain was eaten.

VI. Next day the *P. polites* was not to be seen, but none of the five *P. aristolochiæ* had been eaten, and two at least were still alive.

I then put in five *Danais chrysippus* and three *D. limniace*, which were not touched.

I put in then an *Atella phalanta* and a *Huphina phryne*. The former was soon taken by a Liothrix and discussed by these birds, but they left the body, and the Chloropsis, to which I offered it, soon dropped it.

The *Huphina* was then taken by a Liothrix, but he somehow dropped it, and the Chloropsis took it, and after much manipulation swallowed it.

There were maggots in the cage at the time, besides fruit.

I then put in a dead specimen of *Papilio demoleus*, which was taken by a Liothrix, but not eaten. However, another Liothrix soon took and began to tear it, but I next saw it in the possession of a Bulbul, from which a Liothrix took it when the Bulbul had nearly got rid or the wings (which the Yellow-vented species seems to find it necessary to do), and part was eaten by one of these birds, which did not seem eager for it.

Just after the *P. demoleus*, I put in a dead *D. limniace*, which no bird touched.

I then took away the maggots.

An hour or so later the *D. limniace* were all dead, but not eaten, while all the *D. chrysippus* were gone. The *P. aristolochiæ* were also intact, and the four bodies of *Euplœas* noticed yesterday still lay about.

Towards evening I put in a *Catopsilia*, a female *Elymnias undularis*, a male *Hypolimnas*, and some *Danais genutia* and *D. chrysippus*.

First a Liothrix attacked the *Catopsilia*, then another the *Hypolimnas*, which escaped. Before it was captured (as it lay in the water) a Liothrix took the *E. undularis*.

I took the *Hypolimnas* out of the water, with the *Catopsilia*, which, partly eaten, had fallen into it; while doing this I let a *D. genutia* escape.

The Chloropsis had been hotly pursuing the possessor of the *Catopsilia*.

I also found the *E. undularis* uneaten, except the head.

The birds were not eating much plantain even, apparently preferring the sop.

There were now one *D. genutia* and three *D. chrysippus* in the cage.

However, the Chloropsis soon took the *Catopsilia*, and I think finished it, for it disappeared. Meanwhile a Liothrix pulled to pieces the *Elymnias* and rejected it.

During this the *Hypolimnas* was again attacked by Liothrix, but remained alive, though its wings were much torn.

Then one seized it and took it upon a box in the cage.

I offered the rejected abdomen of the *Elymnias* to the Chloropsis, which carefully crushed and then ate it.

I then saw the *Hypolimnas* being discussed on the floor by a Liothrix, but another of these birds snatched and I suppose ate it, for on looking it was not to be found.

I then took out the five *P. aristolochiæ* and three of the *D. limniace*, none of which had been eaten, though all of the latter and two of the former were headless. One of the *P. aristolochiæ* was still alive. I offered its head to the Chloropsis, which took and rejected it.

While looking for these I found a *D. chrysippus* not quite dead. As it was rather dry I suppose it was not one of the last lot put in, all of which were unhurt and also the *D. genutia*; I threw all these *Danais* out, and all but the nearly-dead one flew away.

VII. After a live *Danais limniace* had been for some time in the cage, and there were maggots there, I put in a dead *Catopsilia*, and single live specimens of *Junonia*, male *Hypolimnas*, and female *Elymnias*.

The Chloropsis immediately took the *Catopsilia*, and the *Junonia* was next taken, I think, by a Liothrix.

I then killed the *Elymnias* and placed it so as to show its mimetic upper surface, and it was attacked and left by a Liothrix, then attacked again, and finally I think eaten by one of these birds, which did not seem to relish it much, as I saw the body on the floor, though this was soon taken.

The *Hypolimnas* was in a corner and was taken last of all, not till I stirred it up, when it was taken by a Liothrix, close to where the maggots were kept, and I think one of these birds ate it.

I then put in a live *Euplœa* and two *Danais chrysippus*, one of which latter was soon killed or disabled.

Yet in the evening none had been eaten, not even the *D. limniace* mentioned above, and a *D. genutia* I put in was only attacked by the Chloropsis, and not with determination by that bird, which, however, pursued quite eagerly a non-warningly-coloured specimen then put in, as also did a Liothrix, but it escaped them, apparently, as I found it behind the water-vessel. On throwing it out, a Liothrix soon took it, and I think it was eaten by this species, as I saw one tearing it, and could find no body.

I offered an *Acræa* to the Chloropsis, which took, chewed, and dropped it; I did not see what happened to it afterwards. I then gave this bird a *Terias*, which he ate.

I took out one of the *D. chrysippus*, which could fly, leaving one other of this species, a *D. genutia*, *D. limniace*, and *Euplœa* in the cage.

To-day and yesterday the birds had a double allowance of maggots.

To-day they had rice and milk, but not, I believe, yesterday. Even when they have this sop they eat papya, though not caring for plantain.

Early next morning I found all the butterflies left over-night still uneaten. The birds had neither butterflies nor sop on this day.

VIII. I put in in the morning, while the birds had plenty of maggots, single specimens of *Euplœa*, *Danais limniace* and *chrysippus*, *Acræa*, *Neptis*, and *Papilio demoleus*, two *P. polites* (non-mimetic), one *P. clytia* and several non-warningly-coloured butterflies including another small Papilio (I think *P. eurypylus*). Most of these were living.

The Chloropsis first attacked, a *Catopsilia;* then a Yellow-vented Bulbul, a small non-warningly-coloured specimen, which I think it dropped.

Then I saw a Liothrix and a Bulbul with a non-warningly-coloured one. The Bulbul left the body of this; but the bird is not healthy.

I do not think the Chloropsis managed to swallow his prey. I saw him try and leave the *Neptis*, which a Liothrix took, and picked off the wings at any rate, while there were non-warningly-coloured butterflies about. But at this time I saw a Liothrix eating plantain.

Here I took out the sickly Bulbul to release it, and meanwhile a Liothrix got out; while keeping the door open to let it in again, one *P. polites* got away, but no other butterflies as far as I saw.

The small *Papilio* was now attacked by a Liothrix, but only the head was eaten.

Lately I saw a Zosterops seize a partly eaten non-warningly-coloured butterfly and peck at a *Catopsilia* in the water. I did not see any eaten. I saw a Liothrix drop a *Catopsilia* and make no attempt to recover it.

I then saw a Liothrix take the rejected small *Papilio*, and afterwards found of it only wings and a bit of the thorax.

I saw a Liothrix peck and leave a *Catopsilia*, of which six lay about, uneaten or nearly so.

I found the body of the *Neptis* outside, and put it in, when it was taken and dropped by a Liothrix.

I saw one of these birds eat the body of, I think, a large non-warningly-coloured butterfly, which body I had seen lying about. There were also a bit of thorax and wings of a non-warningly-coloured butterfly outside; this I gave to the Chloropsis, but did not see what he did with it.

When I left the *Catopsilias* were being attacked.

An hour or more afterwards I found that the mimic had been torn, and its head eaten—not the body. The *D. chrysippus*, *D. limniace*, and *Euplœa* were intact and alive.

The head of the *Acræa* had been pulled off, but lay near, and the body was quite intact, and wings nearly so.

All the other butterflies had been eaten, even *P. demoleus* and *P. polites*, which had not been attacked when I left.

There were still plenty of maggots. These were gone in the evening, but the *D. chrysippus* and *Euplœa* were still intact; however, earlier in the day I found the mimic gone, and the *D. limniace* minus wings and head.

IX. Next day, I found the *D. chrysippus* and *Euplœa* still remaining, and took them out.

I then added one Common Bulbul and one of the Red-whiskered species. The former I shortly removed for a few days.

Soon after putting these birds in, I put in some *Danais genutia*, *D. chrysippus*, and *Euplœa*, with some *Catopsilias*.

These last were devoured first by the Liothrix and partly by the Chloropsis. The Red-whiskered Bulbul beat off the wings of an *Euplœa* and swallowed the body. Yet all day, as far as I saw, a *D. chrysippus* and *Euplœa* remained uneaten; there were also plenty of maggots in the cage.

X. In the evening I offered the Chloropsis a large grey fly, which it ate readily as usual. Then I gave two glossy-green flies, which it chewed and dropped; but these were eaten readily by Liothrix. The Chloropsis then ate another grey fly. There were maggots and fruit in the cage, besides seed.

XI. Next day the maggots in the aviary being all eaten, I put in, in the evening, one specimen each of *Danais chrysippus*, *D. genutia*, and *D. limniace*, one *Euplœa*, and three *Catopsilias*.

The Chloropsis immediately attacked the last and battered one for some time, till a Liothrix took it away.

Another Liothrix got a second specimen, but these birds did not attack as readily or as soon as the Chloropsis. I saw one make a flight at the *Euplœa* when *Catopsilia* was available; it did not catch it.

As the last *Catopsilia* had been killed by a Liothrix, I put in a male *Hypolimnas*. At this time all the "protected" species were unhurt, and part of a *Catopsilia* lay about, which a Liothrix then ate. Meanwhile another snapped at the *D. genutia*. I then turned out the *Hypolimnas*, which had got behind a tin. It was not attacked at once, but looking after dark I found only a wing or two of it left, while the three *Danais* and the *Euplœa* were roosting unharmed in the aviary. There was still fruit to be had.

XII. Next day, when I first looked at the birds early in the morning all the four butterflies, (*Danais* and *Euplœa*) left last night were still unhurt, though soon after I found the latter dead. They remained untouched even though the birds had had no maggots yet, and also after

these were given, and I then took them out; before which was done, I saw the *D. genutia* flutter unharmed before the very bill of a Liothrix.

XIII. I first gave the Chloropsis a *Catopsilia*. I put into the aviary one each of *Danais chrysippus*, *genutia*, and *limniace*, *Euplœa*, *Papilio aristolochiæ*, and *Neptis*, all unhurt. I saw none attacked except the last, and the Liothrix which attacked it did not follow up the attempt. When, however, I put in two non-warningly coloured butterflies, they were attacked and eaten by these birds. There was now no sign of the *Catopsilia* just put in. The *Neptis* disappeared, but may have got out, as I have seen one do once, which I caught.

There were no maggots in the cage, and only a little fruit. The Chloropsis to-day seemed not much to relish a small grey fly given him and lost it without much concern.

After dark I looked in the aviary and found the three *Danais*, *Euplœa*, and *P. aristolochiæ* roosting unhurt.

XIV. Next day, the five "protected" butterflies left last night were all unhurt this morning, yet when I put in a male *Hypolimnas*, it was soon taken by a Liothrix, and the Red-whiskered Bulbul ate some fruit.

I put the Common Bulbul in again.

After some time I saw a Liothrix tearing the *Danais limniace*. No maggots had been given yet, and I could not find the body of the *D. limniace*, so I presume the bird ate it. Soon after I found the *D. genutia* had been eaten, and the *Euplœa* had disappeared, though there were now maggots in the cage; and about an hour later the *D. chrysippus* had been eaten.

I put into the aviary later (where there was fruit and rice-and-milk) one specimen each of *D. chrysippus*, *D. genutia*, and *D. limniace*, *Papilio demoleus*, *Euplœa*, and male *Hypolimnas* and *Elymnias*, also *P. polites*, one mimetic and one not. These were not all put in exactly at once, and the *P. demoleus* was first attacked, but not killed, by a Liothrix. It was, however, eaten by the Red-whiskered Bulbul, while a Liothrix was tearing the non-mimetic *P. polites*. The abdomen of this specimen was eaten, after much fuss, by another Liothrix. The *Elymnias* next disappeared, taken, I think, by the Common Bulbul. This bird next attacked the *Hypolimnas* and ate it whole, apparently.

The *Papilio aristolochiæ* left in last night I found at mid-day, minus its head, and in the evening I saw its crushed but uneaten body. Danaids and *Euplœa* not eaten to-day.

Next day, I found early in the morning the three *Danais* and *Euplœa* still uneaten, and two, *D. chrysippus* and *genutia*, apparently unhurt. There was fruit in the cage. Only the wings of the mimetic

P. polites remained, but in such a position that I suspected ants might have eaten them.

I think the Danaids and *Euplœa* were all eaten later on.

XV. I put in three *Catopsilia*, and one specimen each of *Danais chrysippus* and *limniace* and *Euplœa*. All were dead and rather dry. But although maggots and fruit were available, the Chloropsis immediately, and the Liothrix soon after, attacked the *Catopsilias*. I think part of them was eaten, but afterwards I found one body, and saw the Chloropsis drop its prey or part of it, which the Red-whiskered Bulbul seized, but also dropped, I think, for I found a dry crushed thorax. None of the Danaines were eaten at present.

The Chloropsis was apparently eating the rejected body of the *Catopsilia* when a Liothrix took it.

XVI. Next day, there being plenty of maggots, fruit, and bread-and-milk in the aviary, I put in nine non-warningly-coloured butterflies, and one specimen each of *Danais chrysippus*, *genutia*, and *limniace*, *Euplœa*, and *Acræa*, all dead or disabled.

They were not touched immediately, but before long a Liothrix took a non-warningly-coloured one, and then another did the same. The latter dropped its prey, and I found the abdomen on the floor, which the Chloropsis ate when offered, after much pinching.

The Red-whiskered (apparently) and Common Bulbuls then each took a non-warningly-coloured specimen and ate it. The former bird rejected one non-warningly-coloured specimen which was rather dry, but then ate another. I then saw a Liothrix eat part of a non-warningly-coloured specimen.

The Common Bulbul then ate the *D. genutia*, when it might have taken a *Catopsilia*. This last specimen, the small dried one, and an *Elymnias undularis* ♂ were the only non-warningly-coloured ones left. The Liothrix on this occasion behaved much as I have seen done with "protected" butterflies, pecking their prey about much. The Red-whiskered Bulbul pecked and refused the *Acræa*, which specimen had been also refused by the Liothrix which had refused the small dry non-warningly-coloured specimen.

The Common Bulbul descended and ate the *Catopsilia*, which had been dropped by the Chloropsis, which in turn had got it after a Liothrix. The same Bulbul then flew down and pecked the *Elymnias*, which I had moved nearer the "protected" specimens, but then flew up, perhaps frightened. This *Elymnias* was now apparently the only non-warningly-coloured specimen left. I now saw it pecked and left by the Red-whiskered Bulbul, which had previously been eating some fruit near it. Then a Liothrix took and tore it, and then dropped it,

whereupon the Red-whiskered Bulbul again got it and ate part; perhaps the Liothrix might have also eaten some. But from their marked lack of eagerness one might infer they did not relish it much. The Red-whiskered Bulbul then took and dropped the *D. limniace*.

Later on in the day the Danaines and *Acræa* had apparently been eaten; I saw the wings of the latter; yet there were still maggots left.

I then put in two *Catopsilias*, a *Junonia*, and one specimen each of *Euplœa*, *D. genutia* and *chrysippus*, all alive. A Liothrix seized the *Junonia*, and the Yellow-vented Bulbul attacked a *Catopsilia*, but failed to secure it. However, the Common Bulbul got and swallowed one of these, while the Yellow-vented again attacked the other, which was also persecuted by the Chloropsis. Then the Yellow-vented Bulbul got a good hold of the *Catopsilia*, and was worrying it, when the Red-whiskered snatched it and swallowed it after much battering.

None of the Danaines had been attacked yet, though the Chloropsis tentatively pecked the *D. genutia*. The *D. chrysippus*, however, was soon attacked by the Liothrix and Red-whiskered Bulbul, the latter bird at least eating part of it, though apparently with no great relish. I then saw the *Euplœa* pecked at by a Liothrix and then by the Red-whiskered Bulbul, which wiped its beak afterwards; this bird soon afterwards returned to the attack, beat off two of the *Euplœa's* wings and swallowed it. Meanwhile a Liothrix pecked at the remains of the *D. chrysippus*. Not long afterwards the *D. genutia* had disappeared entirely. There were plenty of maggots still left.

XVII. A few days after, I put into the aviary in the morning (there being fruit and maggots there) one specimen each of *Danais chrysippus*, *genutia*, and *limniace*, *Euplœa*, *Acræa*, and *Neptis*, with several non-warningly-coloured butterflies, *Catopsilia*, &c. A Liothrix took first and dropped the *Acræa*. The Chloropsis attacked a non-warningly-coloured butterfly, but missed it. Then a Liothrix pecked and left a non-warningly-coloured one, which the Red-whiskered Bulbul took and ate. Meanwhile the Chloropsis took a *Catopsilia*, part of which he apparently swallowed. A Liothrix took another non-warningly coloured butterfly, but dropped it. The Red-whiskered Bulbul then descended and took a *Catopsilia* which it battered and then left for an *Elymnias;* then it left this and returned to its original prey, and swallowed this after much trouble. The first insect eaten by the Common Bulbul was this *Elymnias*. A. Liothrix pecked at the body of a large non-warningly-coloured butterfly, which it or another had stripped of the wings, and I think ate it. About this time I saw a Zosterops beating the body of a small non-warningly-coloured specimen on the perch. The Red-whisker-

ed Bulbul soon after attacked another *Catopsilia*, but allowed the Chloropsis (which had previously been attacking these) to take it. The Red-whiskered Bulbul then attacked a male *Hypolimnas*, and ate it with less trouble than the *Catopsilia*. It then attacked another *Catopsilia*, which a Liothrix somehow got, and the Common Bulbul also wanted it. The Liothrix did not seem eager, and another of these birds got the insect, and afterwards the Chloropsis had it.

Then the Common Bulbul ate a bit of a *Catopsilia*. It then made two or three flights to where the *D. limniace* and *Euplœa* were sitting uninjured on the wire-netting, but did not take either. However, it took and ate whole the *D. chrysippus*, the first "protected" butterfly eaten on this occasion. But the *Catopsilia* in the possession of the Chloropsis was now the only non-warningly-coloured butterfly visible.

The *Neptis* and *Acræa* had also disappeared, but I saw no wings about, nor did I see them eaten; probably they got through the netting. The Chloropsis now succeeded, apparently, in eating the body of the *Catopsilia*. There were plenty of maggots.

About an hour afterwards the remaining butterflies (*Euplœa*, *D. genutia*, and *limniace*) were gone, some wings only of the *D. limniace* remaining.

In the evening I put into the aviary (where there was plenty of fruit, but no maggots, these having been taken out) one specimen each of *Neptis*, *Euplœa*, *D. genutia* and *limniace*, and several non-warningly-coloured butterflies.

The Chloropsis soon took a *Catopsilia*, which it ultimately ate, I think. A Liothrix took the *Neptis* (the wings only of which I found afterwards), and the Red-whiskered Bulbul a *Catopsilia*, which it apparently swallowed. The Common Bulbul took a male *Hypolimnas*, which escaped, but the bird caught it again and with difficulty swallowed it. A Liothrix took and picked a *Catopsilia*, which I think it ate; I found no body.

While one *Catopsilia*, the two *Danais* and the *Euplœa* were still left, I put in another *Neptis*, which a Liothrix took at once.

The Yellow-vented Bulbul seized a *Catopsilia*, which escaped; this was the first butterfly touched by it to-day. Ultimately a Liothrix ate nearly the whole of this specimen. Before this also the second *Neptis* had apparently been eaten.

When the birds had roosted the *D. genutia*, *D. limniace*, and *Euplœa* still clung uninjured to the netting.

XVIII. Next morning, only the *Danais limniace* was uneaten, of the butterflies left over-night, and this was headless; later on the body also had apparently been devoured.

In the evening, maggots and fruit being available, I put in a small plain-coloured dragon-fly, which was looked at by the *Chloropsis*, and seized by a Liothrix.

Then I introduced two specimens of *Danais limniace* and one each of *D. chrysippus*, *Papilio eurypylus* and a mimetic *P. polites*, with four non-warningly-coloured specimens.

A Liothrix soon took and ate whole one of the last named, a small one. The Chloropsis took another, which apparently escaped. A Liothrix then took the *P. eurypylus*, which was taken from it by the Common Bulbul and swallowed either by that bird or the Red-whiskered species.

I now took out one *D. limniace* and put in an *Euplœa*.

A Liothrix now attacked with no great zest a non-warningly-coloured butterfly, which another Liothrix took. I had put two of these butterflies into a more prominent position.

The last non-warningly-coloured specimen, a *Catopsilia*, had got behind a dish, whence the Common Bulbul seemed to wish to take it, so I threw it out. The Chloropsis, however, got it, but it escaped twice from this bird, which at last swallowed it with great difficulty.

The two *Danais* and *Euplœa* with the *P. polites* were still unhurt. Next morning, all these were still alive, and the two *Danais* not even hurt; but some maggots also remained from the previous day. I thereupon released all, and all could fly, except the *P. polites*, which was weak and had been in the water.

XIX. The Red-whiskered Bulbul having been released, I offered to the birds (which at this time had had no butterflies for about a fortnight, but had plenty of maggots and other food) a *Junonia* and a *Danais limniace*. Neither insect was attacked at once, though the Chloropsis and Liothrix paid some attention to the former.

I then put in a male and female of *Hypolimnas bolina*, while the other two butterflies had not as yet been touched; neither were these *Hypolimnas* at once. Presently, however, a Liothrix seized the male, but it got away easily, and was not pursued. Shortly after I found the *Junonia* missing, and the body of the male *Hypolimnas*, minus head and nearly the whole of the wings, on the floor. The Chloropsis soon took, beat, and at last swallowed it.

The birds may not have been very eager for insects, since twice to-day during these experiments I saw the common grey house-flies unmolested in the cage.

Next morning I found the female *Hypolimnas* being torn by a Liothrix; it seemed to be already dead. The *D. limniace* had not even been killed, and was, I think, removed when the aviary was cleared.

The birds now had no butterflies for several days, and I commenced a new series of experiments, having considerably changed the *personnel* of the aviary, which now contained only three Liothrix and two Zosterops, the Chloropsis and Yellow-vented Bulbul, and a Sibia (*Lioptila capistrata*) and Mesia (*Mesia argentauris*). The last two species resemble Liothrix in their feeding habits, and the latter is a very close ally of that bird. This occasion was the first on which these two birds had butterflies from me, having been newly introduced.

With these I made the following experiments, of which I give the dates.

Experiments with various Birds (on liberal diet) Series F.

April 30th. I put in two male *Hypolimnas*, one *Euplœa*, one *Papilio panope*, all decapitated. A Liothrix got one *Hypolimnas*, and the Mesia the other, but the Sibia took the insect away from the latter bird. I then put in four more non-warningly-coloured butterflies, all decapitated. The Chloropsis soon had one. While one was still left, I saw the Mesia peck the *Euplœa*, but the bird was frightened off. I put in another decapitated non-warningly-coloured specimen.

I noticed a non-warningly-coloured specimen (which I may have overlooked before) in the food-vessel, which the Sibia soon seized. There were plenty of maggots in the cage, as always lately. I saw the Mesia eat part of a non-warningly-coloured specimen close by the *Euplœa*.

The birds were more eager for butterflies to-day. Nevertheless a Liothrix which had attacked the last non-warningly-coloured specimen, abandoned it, to be soon attacked and apparently eaten by the Sibia.

Only the *P. panope* and *Euplœa* were now remaining, and I put in three females and one male of *Elymnias undularis*. But when I left the birds none of these had been eaten, though a wing had been pulled off from one female. One had got turned underside up before this.

I put in a *Nepheronia hippia* with its wings closed. The Sibia took and dropped it. I then took out the three female *Elymnias*. I saw the Chloropsis at least once drop the head of a non-warningly-coloured butterfly.

May 1st. On looking early this morning I found that the *Euplœa* appeared to have been devoured with the exception of the thorax and three wings. The other butterflies left overnight, the male *Elymnias*, the *Papilio panope* and *N. hippia*, were uneaten, though the head of the latter was missing. I took out the *P. panope*. Early in the day I took away nearly all the maggots, but there was other food in the cage when, in the evening, I put in decapitated specimens of *P. panope*, *Euplœa*, and six non-warningly-coloured specimens, one of them a *Catopsilia*. Almost

immediately the Sibia and a Liothrix had each taken one of the non-warningly-coloured ones, and soon another Liothrix had a third, the *Catopsilia*. I then saw the Sibia take another close by this insect, which it swallowed whole, though as big as *Pontia rapæ*. This bird then took a third non-warningly-coloured butterfly, but a Liothrix took this away after it had partly picked off the wings; however, as I found what appeared to be this specimen on the floor afterwards, I suppose the Liothrix dropped it.

In fact, the Liothrix now, being probably pampered, seem to behave with non-warningly-coloured insects much as the larger Babblers used to do with Danaids.

I think the Sibia finished up the last two non-warningly-coloured butterflies, including one which had been apparently dropped. The *Euplœa* and its mimic *P. panope* remained untouched.

May 2nd. Early in the morning *Euplœa* and *P. panope* were still untouched by the birds, even before maggots were given. Later, after the birds had received their ration of these insects, I found that the *P. panope* had disappeared all but one wing, while even by evening the *Euplœa* was untouched.

There had been maggots and other food in the cage all day, and I now put in three male *Elymnias undularis*, and one each of *Papilio eurypylus*, *P. panope*, *P. demoleus*, *Danais genutia*, *D. limniace*, and *Catopsilia*, all decapitated, and a live *P. aristolochiæ*.

The Sibia first took an *Elymnias*, which the Mesia snatched; the former bird then ate the *Catopsilia*. Then it took another *Elymnias*, but after pulling off part of the wings, dropped it and wiped its beak on the perch. Then it took and dropped the *P. eurypylus*, wiping its beak slightly.

I think the Mesia ate the first *Elymnias*.

A Liothrix then took the *Elymnias* which the Sibia had rejected and ate it, apparently with no great relish. Both from the conduct of this bird and that of the Sibia one might have thought the insect unpalateable.

The Sibia then took the third *Elymnias*, but soon dropped it, whole, and wiped its beak. Yet it evidently wished for more butterflies. I then saw the Mesia with this specimen.

I next put in three non-warningly-coloured butterflies; immediately the Sibia seized one, and had torn off much of its wings, when a Liothrix took it. However, the former bird soon took another, tore off its wings, and apparently ate some. Meanwhile the *Elymnias* taken by the Mesia had disappeared.

The Sibia then ate the *P. eurypylus*, with some slight signs of

disgust, as I thought. I then found the body and part of the wings of a non-warningly-coloured butterfly beneath the Sibia's last perch; but the bird soon ate this body, which it had possibly dropped previously.

Afterwards I saw the Sibia eat another non-warningly-coloured butterfly. The *P. demoleus*, *panope* and *aristolochiæ*, the *D. genutia* and *limniace*, and the *Euplœa* which had been there all day, were still left when the birds went to roost.

May 3rd. In the morning all the butterflies left over-night remained for some time. Later on the *Papilio panope* had been devoured, and the *P. demoleus* had disappeared.

I then released the *P. aristolochiæ*, which now seemed slightly injured, but flew away. Later still the *Danais genutia* and *D. limniace* had apparently been eaten, as I only found wings about; and subsequently to this the *Euplœa* had disappeared, a small bit of wing only being left.

In the evening, there being plenty of maggots and other food in the cage, I put in a *Neptis*, which was seized by a Liothrix; this bird was pursued by the Sibia, which took the butterfly, but soon rejected it, when it was swallowed whole by the Yellow-vented Bulbul.

I then put in one specimen each of *D. chrysippus*, *D. genutia*, and *D. limniace*, *Euplœa*, *P. demoleus*, and a much worn *P. panope*, with a male *Hypolimnas*. This last was soon seized by the Sibia, which ate it after tearing off the wings, not without trouble, partly on account of it toughness, and partly by reason of the other birds; one Liothrix tried to snatch the prey, even hanging from it for a moment. Another Liothrix then took the *P. demoleus*, but dropped it and wiped its beak. The *Euplœa* was then taken by that Liothrix which had tried to rob the Sibia of its prey. The Mesia, however, snatched it from this bird, but let it go, and it flew freely about in spite of this treatment.

The *P. panope* soon appeared to be injured, perhaps by Liothrix, but I did not *see* any bird touch it; it was much rubbed, and hardly recognizable.

May 4th. This morning all the butterflies (*Euplœa*, *Danais chrysippus*, *genutia*, and *limniace*, *Papilio panope* and *demoleus*) left over-night were uneaten. The *D. genutia* had got behind a vessel, so I took it out, and soon after found it minus some of its wings, but uneaten; while of the *P. panope* only the two fore-wings and the thorax remained. The insects had obviously been tried by the birds. The *D. chrysippus* had also been mauled, and a little later I found it minus its head, by which time the abdomen of the *D. genutia* had also disappeared; I think I had noticed previously that its head was gone.

Some time later I saw the *Euplœa*, *D. limniace*, and *P. demoleus*

still untouched. The *D. chrysippus* was no more torn, but was behind a dish. This, and the *Euplœa* remained a long time, but at last the latter appeared to have been eaten, and I found the *D. chrysippus*, rather dry, behind a vessel. There were still maggots and a little other food in the aviary.

I made only two more experiments with these birds. On another day, later, seeing one or two Liothrix peck at a *Danais genutia* (which I had let out) on the outside of the aviary, I put in a nearly-dead specimen of that species, but it was not attacked. The birds had maggots and other food. On a second occasion I noted that the Chloropsis twice took and refused a very harmless-looking small fly, which Liothrix ate readily.

I omit some other experiments made with Mesias and Bulbuls, the general tastes of the latter birds having been made manifest in those already given, and the former showing the same tastes as Liothrix.

I have noticed a keenness for butterflies in other captive birds of the Babbler group, the White-crested Jay-thrush (*Garrulax leucolophus*), the Yellow-eyed Babbler (*Pyctorhis sinensis*), the Orange-bellied Chloropsis (*Chloropsis hardwickii*), &c., and I think all of them probably devour these insects when at large.

SECTION II.

I pass now to the consideration of some insectivorous birds of other groups, with which I have experimented singly, a more satisfactory method. The birds were mostly kept in cages with upright bars, and therefore the butterflies given them were in most cases killed to prevent their escape. My most important experiments under these conditions were made with Drongo-Shrikes, representing a well-marked and very characteristic and abundant group of Passerine birds in the Oriental region. They are birds of fair size and take their prey commonly on the wing, either swallowing it whole, or holding it in one foot while picking off the wings, &c.

I have used two species, the Bhimraj or Racket-tailed Drongo (*Dissemurus paradiseus*), about the size of a Magpie and apparently, from its habits in captivity, more or less omnivorous, and the smaller and much commoner King-Crow (*Dicrurus ater*) which is more strictly insectivorous. I had several Bhimrajs, but only give my experiments with the healthiest bird. It was fed on meat, fruit, and insects, with satoo (meal) made up into paste.

I am indebted to Drs. Alcock and Anderson for taking care of this bird and others during an absence from Calcutta on my part. The experiments were made at the close of 1896.

Experiments with Bhimraj.

November 10*th.*—Gave the Bhimraj several butterflies. It ate, with persuasion, two *P. aristolochiæ* and a *P. polites* (a mimetic specimen) pulling off the head of the first of the former species. It ate several *Danais chrysippus* and three *D. genutia*, all of them (except about two of the former) without persuasion, the insects being simply put to its bill.

There were maggots available.

November 11*th.*—The Bhimraj readily ate all the butterflies given it, including *Papilio aristolochiæ*, *P. polites*, *P. demoleus*, *Catopsilia*, *Danais chrysippus*, *D. genutia*, and *D. limniace*, of which last two one specimen only was given, of the rest two or more. Persuasion was only needed with the *D. genutia* and the last *D. chrysippus* when the bird, rather hungry at first, was becoming satiated.

November 12*th.*—The bird, when it had no food in the early morning, ate a *Junonia* and took and refused a *Papilio aristolochiæ*. The latter remained uneaten all day. Meat and grasshoppers had been given. In the evening the bird ate a *P. demoleus*, and two *P. polites*. At first it ate only half of the last specimen of *P. polites*, then trying and rejecting the *P. aristolochiæ*, and then eating the other half of the *polites* when offered. It then ate two specimens each of *Euplœa*, *Danais limniace*, and *D. genutia*.

November 13*th.*—The first food given to the Bhimraj to-day was three *Catopsilias* and three *Danais chrysippus*. It ate a *Catopsilia* first, and ate all of these before eating any of the *Danais*, though it picked up and rejected one of them. Afterwards it ate two of these *D. chrysippus*, and I put in two more. In the afternoon the Bhimraj ate a *Junonia*, though the three *Danais* and yesterday's *P. aristolochiæ* were in the cage uneaten, (one *Danais* was minus its head).

November 16*th.*—The Bhimraj having had no butterflies for two days, I gave it a *Danais chrysippus*, which it was careless with, and allowed it to escape. Then I offered a *Papilio aristolochiæ*, which was several times taken and rejected. Then I gave the bird a mimetic specimen of *P. polites*, which it ate, without persuasion. It then refused a *D. genutia*, and ate, with pressing, a *D. chrysippus*; then, readily enough, a *Catopsilia*. I could not induce it to eat a second *D. chrysippus*.

The *P. aristolochiæ* was not dead when taken out, though its wings were torn.

November 17*th.*—In the morning I gave the Bhimraj (which had no fresh food by it) a *Danais chrysippus* and a *Papilio aristolochiæ*, neither of which it would eat, though it tried them. Soon after it ate grasshoppers.

In the evening it ate a non-mimetic *P. polites*. Then it tried and refused a *Euplœa*, then readily ate a *Catopsilia*. Next, though pressed, it refused a *Danais genutia*, but ate two *Catopsilias* readily, and after again rejecting this *Danais*, ate four more *Catopsilias*.

November 18*th*.—The *Danais genutia* left overnight was gone this morning, but the "sweeper" might have removed it from the cage. I gave the bird first a *Delias eucharis* and then a *Catopsilia*, both of which it ate with equal readiness. Then I gave it a *D. chrysippus*, which it tried more than once, eating a bit of wing, but finally rejected. This insect then flew away, in spite of having been taken hold of both with bill and foot by the bird. Then I gave a *D. genutia*, which was tried and refused at first, but eaten whole when offered again. Then a *Catopsilia* was given, and eaten at once. The bird then ate one each of *D. genutia* and *D. chrysippus*, but would not eat a second specimen of the latter, which I accordingly took out.

November 20*th*.—I gave the Bhimraj, which was not hungry, a *Delias eucharis*, which it tried and refused, repeating the refusal when the insect was again offered. It did not even touch a *Papilio aristolochiæ*, put on the floor, but ate two *P. demoleus*, one immediately, and the other when picked up and offered to it. It then ate two *Catopsilias*, but not a third, though eating a locust.

November 21*st*.—In the morning I saw the Bhimraj look at, but not touch, the *Delias eucharis* and *Papilio aristolochiæ* which had been left in its cage from yesterday. I then gave it a *Catopsilia* and a *Danais chrysippus* on the floor of its cage. It looked at the *Danais*, and took and ate the *Catopsilia*. I then put in a *D. limniace*, which the bird did not notice much, if at all, and certainly did not touch. Then it refused even to try a fresh *P. aristolochiæ*, but ate with persuasion a mimetic *P. polites*. I left the two *P. aristolochiæ*, the *D. eucharis*, and *D. limniace* in the cage, and put in three *D. chrysippus*.

After the butterflies left had been taken away, I then gave the bird, which was hungry, two specimens each of *Junonia*, *Catopsilia*, and *D. chrysippus* on the floor of the cage. It picked up and ate first the *Catopsilias* and then the *Junonias*, though it picked up and dropped one of the *Danais* before eating the second of the latter. Then, leaving the two *D. chrysippus* in the cage, I put in two *Papilio demoleus* and a *D. genutia;* the bird did not eat these, though eagerly eating meat, and they remained uneaten all day, and were left in at night.

November 22*nd*.—The butterflies left overnight were all uneaten this morning, and the bird, though pressed, refused to eat a fresh *Papilio demoleus*, so I took all out.

November 24*th*.—I gave the Bhimraj a *Papilio demoleus*, which it

tried carefully and rejected. *Danais chrysippus* was also tried and rejected, and *Delias eucharis* barely touched even, while *Junonia*, *Atella phalanta*, and another non-warningly-coloured species were readily eaten as also was a *Catopsilia*. The bird tried to catch a *D. limniace* and one or two *D. chrysippus*, which escaped. The sweeper removed the *D. chrysippus* and *D. eucharis*.

In the evening the bird ate, with persuasion, two *Junonias*, but would not eat *Papilio polites* (non-mimetic) nor *Euplœa*. Finally just at dusk it ate with persuasion a *Huphina phryne*. It had food with it on both occasions, but the meat was stale in the morning.

November 25th.—In the morning the *Papilio polites* left overnight was gone, the *Euplœa* being left. There was food in the cage.

I gave the bird two more *P. polites* on the floor of the cage, one mimetic, and one not. It took the non-mimetic specimen first, and ate it, then the mimic, but showed no great eagerness in either case. I then put in a *P. aristolochiæ*, which was tried and rejected. Then I put in four *Junonias* and one specimen each of *Delias eucharis*, *Danais genutia* and *chrysippus*; the *Euplœa* and *P. aristolochiæ* still remained there. One *Junonia* was eaten at once; then the *D. eucharis* was picked up and dropped; then two more *Junonias* were eaten, and the fourth taken up and dropped. This action the bird apparently repeated once or twice (judging from the insect's varying position in the cage), but it finally ate it when offered by hand.

To-day it seemed not very eager for any butterflies.

In the evening, when the bird was hungry, I gave it (having transferred it to the aviary) dead specimens of both the mimetic and ordinary forms of *P. polites*. It took the non-mimetic form first and ate it, and then took and ate the mimic. I then put in one specimen each of *Euplœa*, *Danais chrysippus*, *D. genutia*, and three *Papilio demoleus*, all alive.

The bird took and dropped the *Euplœa*, and took and mauled, but did not kill, a *P. demoleus*. Later, when the bird had gone to roost, I missed this specimen, but found all the rest untouched, and removed them. From appearances next morning I think ants ate the *P. demoleus*.

November 26th.—The bird was not hungry when I gave it, in the afternoon, two *Catopsilias*, and one each of *Papilio demoleus*, *Euplœa*, and *Danais chrysippus*, all dead, the *Euplœa* and *P. demoleus* being the specimens I had taken out last night. One *Catopsilia* first disappeared; I saw the bird attacking these. Then the bird ate some meat and left the other butterflies. It would not eat the other *Catopsilia*, even when pressed, nor the *D. chrysippus*, which I also pressed on it. I then again pressed it to eat the *Catopsilia*, which this time it consented to do. I

let the bird out for a time, leaving the *Euplœa*, *Danais*, and *P. demoleus* in the aviary. But all three were uneaten when the bird went to roost, and also when I looked next morning.

After this the bird was transferred to the Alipore Zoological Gardens, where it still is.

Experiments with King-crow.

The first bird of this species I got was sickly and soon died. Not however, before it had rejected a *Danais chrysippus* after tearing off the wings, and eaten a *Terias* whole.

The next bird, with which I experimented more than two years after, was healthier and older, but did not do well in captivity. In fact, when I ultimately released it, it was so weak as to fall a prey to a kite, a bird it would naturally attack and tease. It was kept part of the time in a small, and part in a large cage, both with upright wires, and fed on maggots and grasshoppers. I performed with it the following experiments, also towards the end of 1896.

November 16th.—I gave the bird two *Papilio demoleus* and a *Danais limniace*. The *Papilios* were very soon eaten, though the bird was wild, (and hungry too, I think); the *D. limniace* was not eaten. I then put in another *P. demoleus* and one each of *Danais genutia* and *D. chrysippus*. The bird tore off the wings of the *P. demoleus*, but left the body; it did not touch the *Danaids*. I then put in a *Junonia* and a *Catopsilia*; the latter was eaten at once, but the former soon disappeared also and not long after the body of the *P. demoleus* also, the *Danaids* being untouched. I left these in the cage, as night came on.

November 17th.—The *Danaids* left overnight were gone to-day, but I do not know whether the bird ate or the sweeper removed them. I gave the bird in the morning, when it was hungry, a *Danais genutia* and a *D. chrysippus*; it immediately took the *genutia* and tried to swallow it whole. It must have eaten both, for they disappeared, and I saw it swallow a body after picking off the wings. I then put in three *D. chrysippus*, one of which had been refused by the Bhimraj (see Bhimraj under this date) and the *Papilio aristolochiæ* also refused by that bird. I soon saw the King-crow eat one *D. chrysippus*, and not long after found only one left out of the three, with torn wings. The *P. aristolochiæ* was uneaten. Yet the bird soon after ate grasshoppers when given.

By the evening only the *P. aristolochiæ* was left, with more torn wings than before. I then gave the King-crow, which should have been hungry, a non-mimetic specimen of *P. polites*, which it at once ate, nearly whole. I then put in a *Delias eucharis* and a *Catopsilia*, the latter

of which it at once took and ate. I then put in one specimen each of *D. genutia* and *chrysippus*, and three smaller *Catopsilias*, two of which last were soon eaten. Next I put in the *Euplœa* refused by the Bhimraj (see Bhimraj under this date). It was not taken by the King-crow, though soon after the third *Catopsilia* disappeared from the cage. I put in two more *Catopsilias*, one of which was eaten at once. The other remained till dusk, and I took it out with the *Euplœa*, *D. genutia* and *chrysippus*, and *P. aristolochiæ*, which last I threw away. But the *D. eucharis* had disappeared, though I did not *see* the bird eat this, and at any rate it had eaten four or five *Catopsilias* before it could have done so.

November 18*th*.—I offered the King-crow the *Euplœa*, the two *Danais*, and *Catopsilia* taken out last night. It ate first the *Catopsilia*, and then the *D. genutia*, quite readily. Then I put in four *Catopsilias*, three of which were eaten immediately, and not long after the other disappeared, the *D. chrysippus* and *Euplœa* remaining. Quite soon after, the *D. chrysippus* was eaten. Soon after this the bird took the *Euplœa*, pulled off the wings and swallowed the body, but threw this up again and left it. But some time after this also was gone.

In the evening I gave the bird a *Delias eucharis* and three *Catopsilias*; it picked up and ate all of the latter immediately, then picked up and dropped the *Delias*. Soon after, while this *D. eucharis* was still left, I put in specimens of *Papilio aristolochiæ* and *demoleus*, *Junonia*, and *Danais chrysippus*. The *P. demoleus* was taken first, and next *Junonia* disappeared. Then the *D. chrysippus*, which had been refused by Bhimraj (see Bhimraj under this date) was eaten quite readily, as was usually the case when this bird ate "protected" species, so far as I saw.

November 19*th*.—In the morning, the *Delias eucharis* (with part of wings torn off) and *Papilio aristolochiæ* left in the cage overnight, still remained. I put in three *Danais chrysippus*, two of which were immediately swallowed whole, and the third eaten after the wings had been pecked off a little. I then gave the bird two more *D. chrysippus*, one of which it took, and I left it holding the insect in its foot. This disappeared, the other specimen and the *D. eucharis* and *P. aristolochiæ* being still left, but soon after the wings of this second *Danais* were plucked off and it was eaten. Some little time afterwards I gave the bird a *Junonia* which it did not touch as far as I saw, though it had been recently eating maggots, of which it had lately but short allowance. I gave it plenty of these now, and by evening nearly all were gone, but the three butterflies (*Junonia*, *D. eucharis*, *P. aristolochiæ*) were still uneaten. I put in a female of *Elymnias undularis*

a *Junonia* (of another species), and a *Catopsilia*, of which the last was immediately eaten. I put in another *Catopsilia*, which the bird ate after plucking off the wings.

I then took out the two *Junonias*, *Elymnias*, *P. aristolochiæ* and *D. eucharis* from the cage, as it was getting dark, and threw away the last, which was very dry.

November 20th.—I gave the King-crow, which was hungry, the two *Junonias*, the *Elymnias* (with its wings closed, as indeed before) and a *Danais chrysippus*. One *Junonia* was soon taken, but the bird, after tearing off a bit of wing, rejected the insect, possibly because it was dry. But soon after all I had put in were gone. I then put in two *Catopsilias* and two *Delias eucharis*; the former were eaten immediately, the latter not touched. I then gave the bird a *Papilio demoleus*, which it took, and pecked at the wings, and the insect soon disappeared, though I did not *see* it swallowed. I then put in the *P. aristolochiæ* which I had taken out the previous night, with a non-mimetic *P. polites*. Before long I saw the bird pluck off the wings of the *P. polites* and eat it. The two *Delias eucharis* and the *P. aristolochiæ* were still untouched. I then put in a *P. demoleus*, and a *Danais chrysippus* and *genutia*; almost immediately the bird plucked the wings from the *Papilio* and ate it, and soon after did the same with the *D. genutia*. Soon after this maggots were given to the bird. Some time after these and the *D. chrysippus* were gone, while the two *D. eucharis* and the *P. aristolochiæ* were left; and long after this, in the evening, these butterflies still remained, though one *Delias* was minus the head and one hind-wing, and the other also torn. A locust given to the bird had disappeared. I then put in three *P. polites*, two of the mimetic, and one of the non-mimetic form, and also a *P. demoleus*. This last, which was not put in quite simultaneously with the others, was almost immediately seized by the bird, which a little after, took and ate in my sight the non-mimetic *P. polites*. I then put another *P. aristolochiæ* in the cage. Then I saw the bird pick up one of the remaining *P. polites* by the wing and drop it. I put in a *Catopsilia*, and a locust; the bird took the butterfly. Later, at dusk, I saw it eating the locust.

I afterwards took out the two *P. polites* and the fresh *P. aristolochiæ*.

November 21st.—In the morning, the bird being hungry, I put in the two mimetic *Papilio polites*, with a *Danais limniace* and *chrysippus*. The *D. limniace* was immediately taken and eaten.

Soon after I took out the two *Delias eucharis* and the one *Papilio aristolochiæ*, which had remained in the cage all yesterday, and up to now, and threw them away, putting in instead the second *P. aristolochiæ* which

I had taken out last night, with two more *D. chrysippus*. Soon after one of the *P. polites* had disappeared, although the other, with the three *D. chrysippus* and the *P. aristolochiæ* were left. This I observed after I had let the bird out, unfortunately to meet the fate above described.

About this time I also experimented with a Shama (*Kittacincla macrura*) one of the smaller or Robin-like members of the great Thrush group. These birds, as every observer knows, peck their prey to pieces, and do not use their feet to hold it, thus differing widely from their relatives the Babblers, which are a more tropical group. The Shama, however, and many other Thrush-like birds inhabit the Oriental region. This bird was hand-reared and very tame, and I experimented with it in a cage, feeding it on maggots, meal-paste, and small green (dried) insects.

With regard to the probability of birds of this group attacking butterflies, I may say I have seen a Redstart (*Ruticilla sp. ?*), in nature, at Dehra Dun, seize a very large *Catopsilia* I put out for it, decapitated, and apparently it satisfactorily disposed of it.

Experiments with Shama.

November 26th.—I put in the Shama's cage a *Catopsilia*, and afterwards another non-warningly-coloured butterfly, a small greyish species. Both disappeared and were doubtless eaten by the bird.

November 27th.—I put in the cage of the Shama (which was not hungry) a *Catopsilia* and a *Danais chrysippus*. The bird was soon pecking at the former, which shortly disappeared; the *Danais* had also been pecked. A moment after the bird was attacking this, but the body remained uneaten, though most of the wings were picked off. I soon after put in a *Delias eucharis* and a *Junonia*, the latter of which was immediately pecked about and eaten, while the *Delias* was pecked once or twice and left. I then put in another *D. chrysippus*, which the bird pecked to pieces, but did not eat; it then pecked about and ate a male *Nepheronia hippia* which I put in. A little time after this, I found that the abdomen of the second *Danais* given had disappeared; I put in a third specimen and two *Catopsilias*, both of which latter the bird pecked, and then started to attack one, disregarding the *Danais*, and soon ate it. Then it began upon the other, which soon disappeared. The (body of the) first *Danais* given, and the third, with the *D. eucharis* remained uneaten. However the bird soon attacked this third *Danais*, but did not eat it. I then put in four *Catopsilias*, which were immediately attacked, and soon disappeared, the three "protected" specimens being still left. I then put in two *Papilio demoleus*. These were attacked, but less eagerly, but ultimately part of one was apparently eaten, and most of the wings stripped from the

other, while *D. chrysippus* and *D. eucharis* still remained. Later I found, lying in a dry state outside the cage, part of the body of one of these *P. demoleus*, and dried bodies or parts of two *D. chrysippus*. The *D. eucharis* disappeared, I did not notice at what exact time.

In the evening I gave the bird, which was not hungry, but had no butterflies in its cage, three *P. demoleus* and a *D. chrysippus*. It attacked one of the former, but did not persevere, but took and pecked at the *Danais*, and then left it, having apparently eaten its abdomen. I then took out the *Papilios* and put in a *Junonia* and a *Delias eucharis*; the *Junonia* was immediately seized, and soon devoured. I then put in a *Catopsilia*, which was at once seized, and soon disappeared. I then again offered a *P. demoleus*, which the bird pecked at and left. The *D. eucharis* was not touched, and as the bird was about to roost, I took out both it and the *P. demoleus* and threw them away.

November 28th.—In the morning, the Shama not being hungry, I put in two of the *Papilio demoleus* taken away yesterday, together with a *Danais genutia*. The bird pecked first at a *P. demoleus*, then at the *Danais*; it picked this about a good deal, but nevertheless I left it attacking a *demoleus*, and soon found that one of these had disappeared, and the other was much torn, while the *Danais* was intact. I then put in four *Catopsilias*, all of which disappeared, while the *P. demoleus* and *D. genutia* were uneaten; the bird, however, pecked at all, I think, of these *Catopsilias* before eating any; also it picked up and dropped the *D. chrysippus* (left from yesterday) before it had eaten one, and pecked the *genutia* about while a *Catopsilia's* abdomen still remained. Some time after the *D. genutia* had been pecked quite to pieces and its abdomen was gone; the bodies of the *D. chrysippus* and *P. demoleus* were left.

They were still there in the afternoon, and the bird was not hungry. I put in one specimen each of *Junonia*, *Catopsilia* and *D. chrysippus*. The bird did not show much eagerness. First I saw it hold the *Junonia* for some time; then I was put in time to see the *Catopsilia* swallowed, the *Junonia* having meanwhile disappeared; then it began to peck the *D. chrysippus*, and I put in a *P. demoleus* of which the wings were already largely torn away. Very shortly after I found only its forewings, while the *D. chrysippus* was untouched. I then put in another *P. demoleus*, intact, and a *D. genutia*. Soon after I found outside the separated thorax and abdomen with part of the wings, of the *D. genutia*, and the *P. demoleus* minus one wing. I put both back, and the bird pecked the *P. demoleus* and ate the body. The *D. chrysippus* more recently put in was still untouched; I took out the body of the specimen that had remained all day, also that of the *P. demoleus* mentioned *supra* as remaining with it; these were dry.

November 29th.—In the morning, the bird not being hungry, I found the *Danais chrysippus* left overnight in the cage still whole, and the abdomen of the *D. genutia*. I put in another *D. chrysippus*, and a *Papilio demoleus*, of which the latter was first taken, pecked about, and eaten, and the bird was pecking the *Danais* when I put in a non-mimetic *P. polites*. The bird left the *Danais* and pecked off one of the wings of the *P. polites*, and then remained quiet for a little. Soon after I found the *P. polites* had been pecked to pieces, and its body was gone. The head of the *D. chrysippus* put in was also missing. After the bird had been pecking at this insect, I put in a *D. limniace* and a *P. demoleus*. The bird attacked the *Danais* first, pecked off the wings, and ate the abdomen; it then attacked the *D. demoleus*, not very eagerly. Some time after I found the body of the latter, stripped of the wings, outside. I put it in the cage, and the abdomen at all events disappeared, though there were the body of one *D. chrysippus*, and the thorax and wings of another, still there. On emptying the cage, I found the abdomen of some large butterfly behind the tray, and some heads, and bits of thorax there and in the tray itself.

Later on, the bird being still not hungry, I put in two *D. chrysippus* and a *P. demoleus*. The bird pecked at all three, and left them for a while. The *Papilio* was the first attacked, so far as I saw, but a *Danais* was more pecked. Then the *P. demoleus* was again attacked. I was now away for some time, and on returning in the evening found all three butterflies uneaten, and threw them away.

December 1st.—I put in in the morning, the bird not being hungry, two *Danais limniace* and a *Papilio demoleus*. The Shama first attacked a *limniace*, but ate none.

Some hours later, I put in one specimen each of *Junonia*, *Atella phalanta*, and *D. chrysippus*.

The Shama first ate the *Atella*, and then attacked the *Junonia*, which soon disappeared. I put in one non-mimetic *Papilio polites* and two *P. aristolochiæ*. One of the latter was first attacked, but two or three hours afterwards I found it outside, with its wings much torn; the other was almost intact, while the *P. polites* had been pecked to pieces and its body was gone. The *P. demoleus* and the two *D. limniace*, put in early, were still there, the latter having been more attacked than the former, if indeed this *Papilio* had been touched at all. The *D. chrysippus* was untouched. At night, after the bird had gone to roost, I examined the cage and found one *D. limniace*, the *D. chrysippus* and *P. demoleus* uneaten; the other butterflies were not to be found.

December 2nd.—I removed from the Shama's cage, early, the three butterflies (*D. limniace* and *chrysippus*, *P. demoleus*) left overnight; and

later gave the bird (which was not hungry) one male *Nepheronia hippia*, and two *Danais genutia*. First it pecked a *D. genutia*, then attacked the *Nepheronia*, battered off its wings, and ate it, though I did not witness the actual swallowing. Some hours later I found one *D. genutia* in a mangled state outside (and also an abdomen of this species), and the other not at all. I put that which I had found in again, and some hours later found it also gone.

December 4th.—I offered the Shama two non-mimetic specimens of *Papilio polites*, and a *P. aristolochiæ*. The two former were torn up, and their bodies not to be seen; this happened in the case of one very soon, and in that of the other after some time; the *P. aristolochiæ* was not eaten. The bodies of two large non-warningly-coloured butterflies (one a *Euthalia*) disappeared, while one *P. polites* still remained.

I then put in two *P. demoleus* and a female *Nepheronia hippia*. Some time after I found the latter pecked to bits, and its body mostly gone; the same was the case with one of the *P. demoleus*; of the other I found the body outside. I offered it again, and found this time the abdomen outside; this I put in again. The *P. aristolochiæ* still remained uneaten, as did the heads of the *P. demoleus*.

Afterwards I found the *P. demoleus* abdomen gone, and then gave the bird two *Huphina phryne*, and one *Delias eucharis*, the former of which it immediately ate. Very soon also I found the *Delias eucharis* had been pecked to pieces, and its body was gone. I then put in a *P. demoleus*, which at night had disappeared. The *P. aristolochiæ* was still left, though it had been pecked.

December 5th.—I put into the Shama's cage a *Papilio aristolochiæ* and a mimetic *P. polites*; the latter was eaten, or at any rate disappeared, and I put in a *P. demoleus*, which was soon attacked, the *P. aristolochiæ* being untouched or nearly so. About this time I took out the other *P. aristolochiæ* (left from yesterday). The *P. demoleus* was soon disposed of, and its body disappeared; some little time after this also happened with the *P. aristolochiæ*. The bird only had "meal-paste" by way of food, and this was also the case early yesterday. I now put in a *Danais genutia* and a *Catopsilia* of about its size; the latter was taken at once and swallowed almost whole; and a male *Nepheronia hippia* nearly as big had its wings battered off and body eaten. I then put in a *Huphina phryne*, two *Atella phalanta*, and one (smaller) *Catopsilia*, all of which were eaten in the order named; I saw most of them swallowed, all but the *Catopsilia* whole; a *Delias eucharis* put in with them remained untouched like the *D. genutia* previously put in. But immediately after, the bird attacked this *Danais*, whereupon I put in a *P. demoleus*; this however, was not attacked,

the bird preferring to attack both the *Danais* and the *Delias*. Some time after, (maggots having meanwhile been given) the *P. demoleus* had evidently been eaten and the *D. genutia* was gone. I put in two *P. demoleus* and another *D. genutia ;* the latter was attacked. Not long after the two *P. demoleus* had been pecked to pieces, and mostly eaten; the wings of the *D. genutia* had been pecked, but the body was intact; the *Delias eucharis*, which I had noticed as having been pecked when I put in this last lot, was also intact, all but the head. But some time later both the *Danais* and *Delias* had apparently been treated like the *P. demoleus*.

December 6th.—In the morning I gave the Shama a non-mimetic *Papilio polites* and a male *Nepheronia hippia*; the latter was attacked first, and both were apparently eaten, as I could not find them later.

December 7th.—I gave the Shama, which was not hungry and had had insects given it, a *Huphina phryne*, a *Delias eucharis*, and two small *Catopsilias*. Some time after all had evidently been eaten; I did not see which had been taken first.

I then put in one *D. eucharis*, one *D. chrysippus*, one *Catopsilia*, and three *Junonias*. Not long after I found that all had been eaten except *D. eucharis* and *D. chrysippus*, the former of which was minus its head. While these were left I put in two *Papilio demoleus* and two *D. genutia*. Soon after one of the latter had disappeared, leaving no trace. The others remained for some time with the butterflies previously left, but at night the other *D. genutia* had evidently been eaten, and the wings of the *D. chrysippus* had been picked off. But its body was left, as also were the *D. eucharis* and one *P. demoleus*.

December 8th.—The butterflies left last night were still in the cage this morning, almost all of the wings of the *P. demoleus* having been picked off. I put in a non-mimetic *P. polites*, and soon found that it had been pecked to pieces and the body was gone. I then took out the others. Even most of the wings of the *P. polites* seemed later to have been eaten. I put in, before the bird had yet had any insects, a *P. demoleus ;* some little time after I found this also with its wings pecked, but not eaten. I took out the bird and put it into another cage.

December 9th.—I put into the cage of the Shama, in the morning, when it had insects, a male *Elymnias undularis*. A little later the bird had evidently eaten this.

I then put in the cage a non-mimetic *Papilio polites*, and two *P. aristolochiæ*. Looking afterwards, I found the bird had apparently eaten one *P. aristolochiæ*, a small specimen, the other and the *P. polites* being left. Afterwards I saw the bird attacking the latter, and later found it had eaten both. Some time afterwards I found the head of the *P. aristolochiæ*.

December 10*th*.—I put in the Shama's cage two *Papilio aristolochiæ* and a non-mimetic *P. polites*, but they were not eaten. I left them there, and found, about an hour later, that the bird had pecked to bits and apparently eaten the *P. polites* and one of the *P. aristolochiæ*, the second *P. aristolochiæ* still remaining; but afterwards I found that this also had apparently been eaten.

December 12*th*.—The Shama being hungry, I put in its cage a *Papilio aristolochiæ* and *P. demoleus*. The bird pecked the *P. demoleus* to pieces and apparently ate the body. I put in another. After it had attacked this, I put in two *Atella phalanta*, which after a little time disappeared, all but bits of wing. At roosting-time the second *P. demoleus* had apparently been eaten, and the body of the *P. aristolochiæ* lay outside the cage.

December 13*th*.—I must have put back the body of the *P. aristolochiæ* found outside last night, for I note only the abdomen left this morning. The bird had received food (green insects) overnight.

December 16*th*.—I put into the Shama's cage a *Euplœa* and a large non-warningly-coloured specimen. The bird first went for the *Euplœa*, but before long attacked and pecked about the other, which I just missed seeing swallowed whole.

Later, I gave the bird an *Euthalia* and another *Euplœa*; the former was attacked first, but afterwards dropped and the *Euplœa* picked up; but the *Euthalia* was taken again, its wings battered off, and the body apparently eaten; I did not see it. I put in then a *Junonia* and a *Papilio demoleus*, and not long after both had disappeared except part of the wings of the latter. The *Euplœas* were still uneaten.

I put in a *Huphina phryne*, which was immediately seized, and swallowed nearly whole.

At night the *Euplœas* were still uneaten though when I looked in in the afternoon the bird had no food; I gave it some green insects then.

December 17*th*.—The bird had some of the green insects left in its cage this morning, and also the butterflies left overnight. I put in a non-mimetic *Papilio polites* and a small *P. aristolochiæ*. The bird did not attack at once, but soon I found bits of wing only left of the *P. polites*, and the *P. aristolochiæ* untouched, or only slightly torn as to the wings. I put in a *P. demoleus* which the bird attacked before very long, and soon it disappeared, all but one wing; the *P. aristolochiæ* still remaining.

I then put in a small "Blue," a *Terias*, and a *Junonia*. The bird first took and swallowed the last of these; then it appeared to eat some bugs; then it pecked the wing of the *P. aristolochiæ*, and then took the *Terias*. This soon disappeared, all but two bits of wing; I did not *see* it swallowed. The bird then pecked the *P. aristolochiæ* again.

I then put in a *Junonia*, which was attacked and swallowed; then another *P. demoleus*, which the bird at once attacked, but left to eat the "Blue" with less readiness than I should have expected. It soon attacked the *P. demoleus* again, and the insect disappeared, all but parts of wings, whereupon I put in another.

I now had the cage cleaned, taking out this *P. demoleus* and *P. aristolochiæ*, and also the two *Euplœas*, which had remained, all this time, and which I now threw away.

Later, after the bird had had no food for two hours or so, I put in again these two *Papilios*, together with two *Junonias* of different species; these latter almost immediately disappeared, all but some pieces of wing, and I then saw the bird batter the *P. demoleus* and eat the body. *P. aristolochiæ* left.

December 18th.—The *P. aristolochiæ* was still uneaten to-day; the bird had food by it.

I put in the Shama's cage another *P. aristolochiæ*, and one specimen each of *Papilio demoleus*, *Danais genutia* and *D. limniace*. The bird attacked, first *D. genutia*, *P. demoleus*, and *D. limniace*, then *D. genutia* again, then *D. limniace* again, then it attacked *D. genutia* a third time, and then attacked *P. denoleus*, pecked off the wings, and ate the body. I noticed that with the *Danaids* it attacked the end of the abdomen—not so with the *P. demoleus*. It then pecked the *D. limniace*, and then apparently (for the insect seemed to have been moved) for the first time the *P. aristolochiæ*.

Some time after (maggots having been given in the meantime) I found the *D. limniace* pecked to pieces, but not eaten, except probably the head, which was missing. The *D. genutia* was missing, but next day I found it behind the water-tin. The *P. aristolochiæ* was still there; its wings had been pecked. There were green insects as well as maggots in the cage.

Two hours or so after this, the Shama, though there were still green insects in its cage, had apparently eaten both the *D. limniace* and *P. aristolochiæ*.

This ended the experiments with this species, as on the next day I released the bird, which disappeared.

I also made a considerable number of experiments at this time with a Starling, the Indian *Sturnus menzbieri* probably, a bird practically identical with the common European species. Starlings are omnivorous and feed largely on the ground, like Thrushes, and so are probably less important as enemies to butterflies than some other birds. They do not use their feet in feeding, but this species at any rate can dispose of a large prey easily enough by swallowing it whole.

Experiments with Starling.

December 8th.—The Starling having been put into a cage in which was a specimen of *Papilio demoleus*, soon apparently ate the insect; and also I think a *Catopsilia* and another (brown) non-warningly-coloured butterfly.

December 9th.—I put in the cage of the Starling, which was, I think, hungry, a specimen each of *Junonia*, *Danais chrysippus*, *Delias eucharis*, and *Catopsilia*. The bird ate the *Junonia* and then the *Catopsilia*, whole. I then put in a *Junonia* of another species, which was also eaten whole. Very soon after I found the *D. eucharis* and *D. chrysippus* also gone. Later on I put in a *Junonia* and a *Huphina phryne*, together with another *D. chrysippus* and *D. eucharis*. The bird ate first the *Junonia*, then the *Huphina*, and then the *D. eucharis*. I left the *D. chrysippus*, which had not yet been touched, in the cage, and soon after found it outside. I put it in again, with a *D. genutia* and *D. limniace*, and gave the bird at the same time a tin of bread-and-milk. Very soon I saw it energetically attack the *D. limniace* and swallow it, though the biggest butterfly given. Later I found the *D. genutia* untouched, though the *D. chrysippus* had long disappeared and the bird ate maggots; and in the evening, though the bird had eaten up all these and also the artificial food, this *D. genutia* was still untouched. A young cockroach given in the afternoon had soon disappeared.

December 10th.—I put in the Starling's cage, where the *Danais genutia* given yesterday still remained, torn but uneaten, the body, in two pieces, of a large yellow-underwinged moth; it soon disappeared.

Later, when there was no food in the cage, I put in one specimen each of *Atella*, *Euthalia*, *Papilio demoleus*, and *Euplœa*. The *Euthalia* was eaten immediately, but though the bird picked up the *P. demoleus* and touched the *Euplœa*, it did not seem inclined to eat them or the *Atella*. Yet it ate green insects (*Iassidæ*) readily when given. I took out the *Euplœa*, *P. demoleus*, and *Atella*, leaving in the *D. genutia*. Later on I put them in again, with a *Junonia* and a *Catopsilia*.

The *Catopsilia* only disappeared, and I left the rest, putting in another *Atella* and a *Delias eucharis*. An hour or two later one *Atella* and the *Junonia* lay outside; none had been eaten. I put back those found outside, and added another *D. eucharis*.

After the bird had roosted I examined the cage and found none of these butterflies eaten.

December 11th.—Although there was no food in the Starling's cage, the butterflies left overnight (two each *Atella phalantha* and *Delias eucharis*, one *P. demoleus*, *Junonia*, and *Euplœa* with the old *D. genutia*) were uneaten in the morning, at first. Later, first the *P. demoleus* dis-

appeared, and afterwards I saw the bird eat part of the *Junonia* (I had put in part I found outside). The other butterflies were not eaten for some time, though they had been pecked, and the bird ate maggots (which had been given) readily. It also greedily ate a green tree-cricket. I put in another *P. demoleus*, and an hour or two later found one of this species nearly intact, but with much pecked wings, and part of another, outside. I put them in, and the fragmentary one soon disappeared. Of one *D. eucharis* also only a bit was left; the others had not been eaten. The bird had now no other food but these butterflies and I put in a third *A. phalantha*.

An hour or so after, the bird had apparently eaten only a bit of one of the previously-given *Atellas*, and the bit of *D. eucharis*; however I now saw it attack the *P. demoleus*, and eat some, leaving only a little.

At roosting-time it had done no more.

December 12th.—The state of things in the Starling's cage was still the same. I found a piece of a butterfly outside, which I put in, and saw there was another fragment inside too, one of which was part of a *P. demoleus*, and the other might have been this or *D. eucharis*. I took both out, and also the two *Atellas*, the *Delias eucharis*, *Danais genutia*, and *Euplœa*. Later, the bird being hungry, as there was no food in the cage, I put in a *D. genutia* and two *Junonias* and an *Atella*. The bird immediately devoured the two *Junonias*, and pecked and rejected *Atella*. However, this butterfly soon disappeared, and I put in another with a *Papilio demoleus*, *D. limniace*, and *Euplœa*. The bird picked out and swallowed the *Atella*, then pecked at the *P. demoleus*, which it apparently ate, as I only found bits of wing. Then, after pecking at a *D. chrysippus*, and perhaps at others, it swallowed the *Euplœa*.

I then put in a *Huphina phryne* and four *Junonia*, all of which the bird ate at once. It then shortly pecked and ate the *D. limniace*, and by roosting-time both the *D. genutia* and *D. chrysippus* had also disappeared. I have not noted when the last named was put in.

I then put food, green insects, into the cage.

December 13th. The Starling in the morning, though not hungry, ate the abdomen of a *Papilio aristolochiæ* from the Shama's cage.

I put in two *Danais chrysippus*, and some time after they were still uneaten, though one or both were minus heads; when, however, I put in a *Junonia*, the bird immediately ate it, though it had plenty of green insects. These two *D. chrysippus* remained uneaten all day in the Starling's cage. Next day by evening one had apparently been eaten, the other not. The bird had both green insects and bread-and-milk as food.

December 16*th*.—I put in the cage of the Starling, which was not hungry, several small butterflies, *Terias*, *Huphina phryne*, a *Catopsilia*, an *Atella phalantha*, and a small brown non-warningly-coloured species. All but *Atella* were soon eaten. The *Danais chrysippus* left two days ago was still in the cage. I then put in a *Danais limniace*, *Delias eucharis*, and two *Papilio demoleus*, and soon after found all these gone but the *Delais eucharis*, a wing or so of the *D. limniace*, and the head of one *P. demoleus*. The *Atella* had also disappeared, all but a bit of wing, but the old stale *D. chrysippus* still remained.

At night, though at one period in the afternoon I found no food in the cage, when I gave the bird some green insects, this *D. chrysippus* and *D. eucharis* were still uneaten.

December 17*th*.—The two butterflies left overnight, and some green insects, were still in the bird's cage when I put in a fine large *Papilio aristolochiæ* and a *P. demoleus*. Immediately the bird attacked the *P. aristolochiæ* and greedily swallowed it whole, and very soon after the *P. demoleus* also.

I then put in a *Danais limniace* and three *P. demoleus*. The bird attacked the *Danais* first, but left it and took and swallowed a *P. demoleus*; then it again attacked the *Danais* (possibly because it fluttered, not being quite dead), and left it to eat a *Papilio*; the third *P. demoleus* then disappeared, evidently swallowed like the others.

After having given another *P. demoleus* to the Starling, I gave it two *Junonias* of different species; these soon disappeared.

The Starling certainly attacked the last *P. demoleus* before the *D. limniace* I had put in earlier, and apparently ate part of it. I saw it attacking the *Danais*, however and it apparently ate part of it. But I found part of it, and also parts of three *P. demoleus*, so that all could not have been eaten whole as I thought.

The *D. chrysippus* which had been so long in the cage was also broken up, but the *D. eucharis* remained.

I now had the cage cleaned, and the butterflies removed.

December 18*th*.—I gave the Starling, which had food by it, a *Papilio aristolochiæ*, together with a *P. demoleus*. The bird looked at the *P. aristolochiæ* and took and swallowed the other.

I then put in a fresh *P. aristolochiæ* and an *Atella phalantha*. The bird at once ate the *Atella* without noticing the *P. aristolochiæ*, and then merely looked at the latter.

I then offered a *Neptis* and a *P. demoleus*. The Starling timidly advanced, seized, and swallowed the *Neptis*. It seemed to fear the *Papilio*, which was not quite dead, and lay with its wings spread facing the bird, which however seized and ate it as soon as it had swallowed the other.

I then gave the Starling a *Huphina phryne*, and another non-warningly-coloured butterfly, both of which it ate at once, as also an *Atella* which I then gave it.

I took out the second *P. aristolochiæ*.

I put in then *Euplœa*, *D. chrysippus*, and *D. genutia*. The bird at once ate the *Euplœa*.

Some time after, maggots having been given to the bird in the meantime and eaten, I found in the Starling's cage the one *P. aristolochiæ* left there untouched, also the *D. chrysippus*; the *D. genutia* had been pecked to pieces, but not eaten, except perhaps the head. The bird had now no food but a little fruit, so I gave it some green insects.

Two hours or so after, the Starling, in whose cage some insects still remained, had not eaten the butterflies above-mentioned (*P. aristolochiæ*, *D. chrysippus* and *D. genutia*); nor were they eaten when I looked next morning. After this I ceased experimenting, and took the bird to the Zoological Gardens.

Experiments with Mynah.

I also made at different times a few experiments with a close ally of the Starling, the Common Mynah (*Acridotheres tristis*) with birds at liberty.

July 9th, 1895.—I gave a *Papilio demoleus* to a wild Mynah which I had seen trying to get at some butterflies in an insect-cage. The bird knocked off most part of this butterfly's wings and flew off with the body.

July 11th.—I put a disabled *Danais genutia* in the compound, when a Mynah, which was on a building, came down almost at once, seized and battered the insect, and ate most of it; I found the head and a bit of thorax (attacked by ants) and some wings on the ground.

I then put out another, and a *Catopsilia*; but they remained unnoticed by the Mynahs for some time.

July 17th.—I put a disabled *Catopsilia* and *D. limniace* in view of two Mynahs. One of them took first the *Catopsilia*, which was nearest, then the *Danais*, beat them on the ground, singly and together, knocking off a fore-wing of each; it then flew with them to a high building, where I did not see what followed.

November 2nd.—I put out a disabled *Papilio aristolochiæ* and *P. demoleus* on a lawn. Two Mynahs came near, and one ran to the *P. demoleus* and pecked it about, while the other, after looking on and possibly pecking the insect also, went up to the *P. aristolochiæ*, which it pecked, but left almost immediately.

On going up to the spot, I found the *P. demoleus* uneaten, but minus its head, and the other intact, though motionless.

Experiments with Hornbill.

With these birds also my experiments have been few, but interesting results were got from some of them.

The species was the common Black and White Hornbill (*Anthracoceros*) and I experimented with two specimens, but the first bird, which was allowed to go about the compound with clipped wings was unfortunately soon stolen, and the second did not care about insects at all. The following, therefore, applies to one bird only.

December 8th, 1896.—Hornbill, though not eating table-scraps and fruit very well, ate a Skipper, and ravenously devoured two grasshoppers.

December 12th.—I offered the Hornbill some dry dead butterflies from other birds' cages. It readily ate *Catopsilias*, *Atellas*, a bit of *Papilio demoleus* and of some other butterfly; also a *Delias eucharis*, after rubbing this last. It took, rubbed, and refused *Danais chrysippus* and *D. genutia* and *Euplœa*.

I then offered it more butterflies, many of them dead and dry. It ate several *Catopsilias*, one *Huphina phryne*, and several *Junonias*, although it was not without trouble that I got the bird to eat one of these last, and another it would not eat at all. It also refused one *P. demoleus*, though eating another of this species.

It would not eat *D. chrysippus* and *genutia*, nor *Papilio aristolochiæ*, though the two former were fresh, and it afterwards ate many dried grasshoppers.

December 13th.—Offered the Hornbill, which had had some fruit, two *Catopsilias* and two *Danais chrysippus*.

It ate the *Catopsilias*, but took and refused the *D. chrysippus*. Also on another occasion to-day it refused a *D. chrysippus*. It ate, when pressed, a protectively-coloured moth.

SECTION III.

Summary and Conclusions.

I have nothing to add to what I said concerning Mammals and Reptiles, &c., in the papers devoted to them (J. A. S. B, LXV., *Pt. II*, 1896, *p.* 42; LXVI., *Pt. II*, 1897, *p.* 528), for I do not intend to compare them with Birds, since my experiments with the former were limited to one species of each class. I shall therefore confine these remarks to Birds only.

The common Babblers (*Crateropus canorus*) dealt with in my first paper (J. A. S. B., LXIV., *Pt. II*, 1895, *p.* 344) ate the Danaine butterflies readily enough in the absence of others, but when offered a choice showed their dislike of these "protected" forms by avoiding

them. This avoidance was much more marked when the birds were at liberty, though even so a few of the objectionable butterflies were eaten.

Delias eucharis and *Papilio aristolochiæ* were also disliked by this bird, more especially the latter.

Although I did not experiment on any of them at liberty, my experience with the Liothrix (*Liothrix luteus*), Mesia (*Mesia argentauris*), Bhimraj (*Dissemurus paradiseus*), King-crow (*Dicrurus ater*), Starling (*Sturnus menzbieri*) and Shama (*Kittacincla macrura*) was similar, in that all of these birds objected to the *Danainæ*, *Delias eucharis*,* and *Papilio aristolochiæ*, (especially, as a rule, to the last) in comparison with other butterflies, or absolutely.

I never *saw* the Chloropsis (*Chloropsis aurifrons* or *malabarica*) or the Sibia (*Malacias capistrata*) eat *any* "nauseous" butterfly, except that in the case of the former, one *Euplœa* body and a few bits of wing were eaten.

The latter bird refused with apparent dislike the male of *Elymnias undularis*, which should be palateable, and was as a matter of fact usually liked by the birds to which I offered it. Another mimetic species, *Papilio polites*, was not very generally popular with birds, but much preferred to its model, *P. aristolochiæ*.

The Hornbill refused *Danainæ* and *Papilio aristolochiæ* absolutely, but ate the only *Delias eucharis* given.

In several cases I saw the birds apparently deceived by mimicking butterflies. The Common Babbler was deceived by *Nepheronia hippia* and Liothrix by *Hypolimnas misippus*. The latter bird saw through the disguise of the mimetic *Papilio polites*, which, however, was sufficient to deceive the Bhimraj and King-crow.

I doubt if any bird was impressed by the mimetic appearance of the female *Elymnias undularis*. But this is not a first-rate imitation, and a mimic is put to a very severe test when offered to a bird in a cage or aviary.

Young hand-reared birds, like the Shama and Bhimraj, had no instinctive knowledge of the "nauseous" forms, and ate them quite readily at first, but soon gained experience. Birds caught when old, when watched from the first, like the Sibia, first Mesia and Starling, appeared to know and avoid unpalateable species. The latter bird's action in greedily devouring the first whole *Papilio aristolochiæ* given, and then avoiding this species, seems to show it did not know this insect, and had no general prejudice against Warning Colours.

So far the results of these experiments on the whole bear out the

* The first Mesia had not this species offered to it, but those subsequently kept had, and evidently disliked it.

accepted theory, but certain birds, like the Lizards, were more indiscriminate in their tastes.

The two Red-vented species of Bulbuls (*Molpastes bengalensis* and *Otocompsa emeria*) when they would eat butterflies at all (some were very reluctant to do this) showed little discrimination, and often devoured the *Danainæ* as readily as other kinds. The contrast in this respect between these birds and Liothrix, when kept under the same conditions, was very noticeable.

The Yellow-vented species (*Molpastes leucotis*) though the only bird by which I saw *Acræa* eaten, was rather more discriminating on the whole towards the *Danainæ*, and all three agreed in objecting, as a general rule, to *Delias eucharis* and *Papilio aristolochiæ*.

With the White-crested Bulbul the experiments were too few to be of much use, but it does not seem to be very discriminating.

The Button-Quail (*Turnix taigoor*) was also very ready to eat the *Danainæ*, and objected to the other two protected forms above specified. But I do not consider the tastes of this little ground-bird of any importance, and in fact did not keep it for experiment.

The Bulbuls offer a more serious difficulty, as they are very common birds, and undoubtedly do eat butterflies in a wild state. I have myself seen a wild individual of one of the Red-vented forms eat a white butterfly. Experiments should be made by those who have the opportunity with wild Bulbuls getting their own food.

Mynahs (*Acridotheres tristis*) in the few experiments made, cared little for butterflies, or showed no great discrimination when taking them, though at liberty.

Though most birds which are at all insectivorous with which I experimented, captive or wild, showed more or less desire for butterflies, some would not eat them at all, Crows (*Corvus splendens*) for instance.

I conclude from these experiments—

1. That there is a general appetite for butterflies among insectivorous birds, even though they are rarely seen when wild to attack them.

2. That many, probably most species, dislike, if not intensely, at any rate in comparison with other butterflies, the "warningly-coloured" *Danainæ*, *Acræa violæ*, *Delias eucharis*, and *Papilio aristolochiæ*; of these the last being the most distasteful, and the *Danainæ* the least so.

3. That the mimics of these are at any rate relatively palateable, and that the mimicry is commonly effectual under natural conditions.

4. That each bird has to separately acquire its experience, and well remembers what it has learned.

That therefore on the whole, the theory of Wallace and Bates is

supported by the facts detailed in this and my former papers, so far as they deal with Birds (and with the one Mammal used). Professor Poulton's suggestion that animals may be forced by hunger to eat unpalateable forms is also more than confirmed, as the unpalateable forms were commonly eaten without the stimulus of actual hunger—generally, also, I may add, without signs of dislike.

To future experimenters I would offer the following hints derived from my experiences as detailed in this series of papers.

1. Use animals at liberty for experimenting with if possible.

2. If these are not available, confine your subjects singly, and feed them well and *naturally*, letting them be neither hungry nor pampered. Cages should be of portable size (about two feet every way) and made (for birds) of half-inch mesh wire netting with plain wooden floor without a tray. This is to prevent insects getting out or being concealed.

3. Use wild-caught specimens in preference to hand-reared ones.

4. *Remember that the best and often the only way to determine an animal's tastes is to offer it a choice.*

A List of the Butterflies of Bali, Lombok, Sambawa and Sumba.—*By* Lionel de Nicéville, F.E.S., C.M.Z.S., *&c., and* H. J. Elwes, F.R.S., F.L.S., F.Z.S., F.E.S.

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The Islands of Bali, Lombok and Sambawa in the Malayan or Eastern Archipelago extend almost in a straight line from Java on the west to Flores on the east; Sumba or Sandalwood Island lies to the south of Flores; all the islands are adjacent, with narrow straits between them. In continuation of this line of islands from west to east are Flores, Adanara, Ombai and Wetter, with Timor, the largest island of them all, lying to the south of the two latter. Herr J. Röber in Tijd. voor Ent., vol. xxxiv, pp. 261-322 (1891), has written a paper on the butterflies of Flores, Wetter, and Timor; while Mynheer P. C. T. Snellen has in the same periodical, vols. xxxiii, p. 98 (1890), and xxxiv, p. 229 (1891), described the butterflies of Flores. Unfortunately neither of the present writers possesses any considerable collections of butterflies from any of these islands, but which should certainly be compared with those given in this paper. As far as possible we have brought together